



**AGRICULTURAL RESEARCH INSTITUTE**  
**PUSA**







THE  
PROCEEDIN  
OF THE  
LINNEAN SOCIETY  
OF  
NEW SOUTH WALES.

FOR THE YEAR  
1910.

Vol. XXXV.

WITH THIRTY-ONE PLATES.

Sydney :  
PRINTED AND PUBLISHED FOR THE SOCIETY  
BY  
F. CUNNINGHAME & CO. LTD., 146 PITT STREET.  
AND  
SOLD BY THE SOCIETY.  
1910-11.

**F. CUNNINGHAME & CO. LTD.,  
LETTERPRESS AND LITHOGRAPHIC PRINTERS,  
PITT STREET, SYDNEY.**

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# CORRIGENDA.

- Plate II. is incorrectly lettered Pl. i.  
 Page 195, line 34 --for *Dichelia diptheroides*, read *Dichelia diptheroides*.  
 Page 312, line 4-- for (Plates iv.-viii.) read (Plates iv.-ix).  
 Page 322, in the legend of text-fig.1 for ( $\times 2$ ), read ( $\times \frac{1}{2}$ ).  
 Page 326, in the legend of text-fig.2--for ( $\times 25$ ), read ( $\times 16$ ).  
 Plate iv. is wrongly lettered Pl. v.  
 Plate v. is wrongly lettered Pl. iv.  
 Page 376--After Plate vi.(wing venation) read (all figs. 5).  
 „ After Plate vii.(appendages, etc.) read (figs.1 23. > 4).  
 Page 377--Figs.24 26, after penis read ( $\times 11$ ).  
 „ Plate viii.(larvæ); Fig.1, for ( $\times 10$ ) read ( $\times 7$ ).  
 Fig.2, for ( $\times 4$ ) read ( $\times 3\frac{1}{2}$ ).  
 Figs.3 and 5, for ( $\times 9$ ) read ( $\times 8$ ).  
 Fig.4, for ( $\times 25$ ) read ( $\times 22$ ).  
 „ Plate ix.(labia of nymphs) - Figs.1-5, for ( $\times 25$ ) read ( $\times 12$ ).  
 Page 435, line 23--for Pericallini, read Pericalini.  
 Page 441, line 14-- for *A. scabritatis*, read *A. scabritata*.  
 Page 459, line 32 for *Ankistrodesmus nit-schioides*, read *Ankistrodesmus nit-schioides*.  
 Page 493, line 30 --for var. *platycerum*, read var. *platycerum*.  
 Page 550, line 17--for *Allium porrum*, read *Allium porrum*.  
 Page 733, line 15 } for *E. quadriceps*, read *R. quadriceps*.  
 Page 734, line 29 }  
 Page 733, line 19 }  
 Page 734, line 32 } for *E. ulumbrata*, read *R. ulumbrata*.  
 Page 740, line 11 }  
 Page 735, line 29- for *E. flavipes*, read *R. flavipes*.  
 Page 740, line 13--for *E. ornensis*, read *R. ornensis*.  
 Page 740, line 26 --for the tenth and eleventh, read the tenth and eleventh joints.  
 Page 743, line 1 for metasternum, read mesosternum.  
 Page 764, line 20--for the type, read the specimen described.  
 Page 767, line 21--for darker, read dark.  
 Page 772, line 1- for *L. phantasma*, read *S. phantasma*

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PROCEEDINGS  
OF THE  
LINNEAN SOCIETY  
OF  
NEW SOUTH WALES.

WEDNESDAY, MARCH 30TH, 1910.

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The Thirty-fifth Annual General Meeting, and the Ordinary Monthly Meeting, were held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, March 30th, 1910.

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ANNUAL GENERAL MEETING.

Mr. C. Hedley, F.L.S., President, in the Chair.

The Minutes of the preceding Annual General Meeting (March 31st, 1909) were read and confirmed.

The President delivered the Annual Address.

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PRESIDENTIAL ADDRESS.

LADIES AND GENTLEMEN—

It is the duty and the privilege of your President to conclude his year of office by an Address at the Annual Meeting. Custom requires that these addresses should consist partly of a history of the Society during the past year and partly of a philosophical treatise intended for the delectation of members. To prepare an Address worthy of submission to so intellectual an audience is the heaviest responsibility of the Presidency. I crave your

indulgence for an effort which falls below the high standard to which my predecessors have accustomed you.

The greeting "Ladies and Gentlemen" reminds you that at the instance of Prof. Wilson the Society early in the year resolved to break down the invidious distinction between the sexes and to extend full privileges of membership to women. As far back as 1885 women have been received by the Society as "Associates" but excluded from meetings and denied a vote. Eight lady Members joined us under these restrictions, half of whom continue to the present. This enfranchisement was a natural progress and was foreseen by my predecessor, President Stephens, who in his Annual Address of January 27, 1886, made the following reference to the admission of women:—"This enlargement of the Society's sphere is admittedly only tentative, and may probably be increased hereafter by the admission of all Members to full rights without distinction of sex, following the improved practice of the Sydney University in this respect." That the status of our women Members should be thus raised is also in harmony with the provisions of the Founder's will directing that women who are otherwise qualified should be eligible for election to the Linnean Macleay Fellowships.

In this reform you followed the example of our great namesake the Linnean Society of London. But whereas the English women had fairly earned their reward by several brilliant papers accepted and published by their Society, no such feminine contributions have been received from our Members. Neither have Australian ladies so far taken much advantage of the membership now open to them. Yet I anticipate that in the future we shall welcome many distinguished women of Science to our ranks and that their work will be an ornament to our Proceedings. And if not, "Because right is right," as Tennyson says, "to follow right were wisdom in the scorn of consequence."

These alterations necessitated the revision and issue of a new edition of the Rules in December last. Accompanying it was a list of Members, from which it appears that we commence the Session of 1910 with 130 effective Members on the roll.

On January 25th, 1875, this Society was inaugurated by 125 Members, and in 1890 only 24 of these foundation Members continued their association.\* To-day but three of these pioneers remain to us—Sir Normand MacLaurin, Mr. H. H. B. Bradley, and Mr. George Masters—though seventeen others who have not maintained their membership are still happily alive. These survivors are Sir Philip Sydney Jones, Sir J. R. Fairfax, Professor Liversidge, Drs. Cox, Ramsay, and E. Chisholm, The Hon. H. H. Kater, Messrs. T. Brown, J. Brazier, A. Dodds, J. J. R. Gibson, H. A. Gilliat, W. H. Hargraves, C. W. Lloyd, F. Lark, H. Makinson, and G. Osborne.

During last Session eight elections added to us six effective Members, one Member resigned, and we mourn the decease of another. This year death had almost passed us by, but turned to snatch one of our younger brethren. Thomas Cahill Dwyer entered the Training College in 1902, and won the Departmental scholarship to the University, where he took his degree of Bachelor of Science in December, 1905. Next year he was appointed to the position of Resident Science Master in charge of the Bathurst Technical College, a post he filled with credit until failing health compelled his retirement. After a long illness he expired on August 23rd, 1909, at the early age of 30. His removal from Sydney to Bathurst deprived him of the opportunity of attending meetings, and so he was personally known to but few of us. Those who enjoyed the privilege of his acquaintance saw in him the promise, broken by his failing health, of scientific achievement.

After the above had gone to press, I heard with regret of the unexpected death of our ex-Member, Mr. G. W. Kirkaldy, of Honolulu, on Feb. 2nd of this year. He contributed to our Vol. xxxiii., a valuable "Catalogue of the Hemiptera of Fiji." In a previous article, Hawaiian Sugar Planters' Exper. Station, Ent. Bull. iii., 1907, Introduction, he offered a sketch of the Australasian zoogeographical divisions from an Hemiptera standpoint.

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\*These Proceedings, xiv., p.1300.

For the last year the output of work has been well maintained. As new recruits we welcomed Drs. J. B. Cleland and E. W. Ferguson, Messrs. T. H. Johnston and A. F. B. Hull, while veteran Members continued their work on Bacteriology, Botany, Biochemistry, Comparative Anatomy, Conchology, Entomology, various branches of Invertebrate Zoology and Geology. Their writings advance Australian Science in these branches, and will, I trust, prove fruitful of further thought and deed.

Our Annual Volume, No. xxxiv., embodying these researches, was promptly completed and distributed. It contained about eight hundred and fifty pages, and was illustrated by sixty-nine plates. In bulk it equals the united annual product of other Australian scientific societies, and we may, I think, without conceit, regard it with satisfaction. The increasing demand abroad for our publications is accepted as a token of appreciation from those qualified to express it. Recently the standard of our volume has been visibly raised by the highly trained specialists now engaged by the Society.

In discharge of the trust imposed on us by the Founder, and mindful of these words by President Stephens, "on satisfactory proof being given to the Council that the holder has laboured during the preceding term with earnestness, perseverance and success," Dr. Petrie, Mr. Goddard, and Mr. Cotton were approved and re-appointed for the ensuing year as Linnean Macleay Fellows.

Though Dr. Jensen retired from a Fellowship two years ago, he has continued to enrich our Proceedings with geological information obtained during his term of office. It was a gratification to his fellow Members to learn that the Syme Prize for the encouragement of research work in natural science was last year awarded to Dr. Jensen by the University of Melbourne.

During the past year the Macleay Bacteriologist has investigated several problems connected with opsonic activity. The opsonins are those bodies, contained in the blood and body fluids, which assist the white blood corpuscles or phagocytes to absorb all microbes, including those which excite disease. They exist

already formed in the body-fluids to a certain extent, and assist in the maintenance of health. An increased quantity of opsonin in the body may be produced by the injection of dead bacteria or by the consumption of yeast.

Since dead bacteria and yeast can increase the opsonic content of the blood, the question arises, are the opsonins produced directly from the bodies of these micro-organisms, or are they formed indirectly in response to a stimulus given by their products of digestion? Experiment showed that they are not formed directly, from which it follows that their products of digestion stimulate the activity of some opsonin-producing organ.

It is a curious fact about the action of opsonins that by diluting fresh blood serum we obtain an increase in its opsonic activity. The reason was not known until investigations were undertaken in the Society's laboratory. As a result of much experimentation, it appears that the cause of the phenomenon lies in the activity of the phagocytes. The salinity of normal blood serum is too high for a maximum phagocytosis, and therefore by weakening the percentage of salt, the gradual dilution brings the serum to a point at which the phagocytes can work best. From this point a further dilution lessens both opsonic content and phagocytic activity. Less important factors in controlling the phenomena are the relative abundance of bacteria to be ingested, the nature of the phagocytes, and the duration of the period of contact between opsonised bacteria and phagocytes.

In the domain of economic bacteriology, Dr. Greig-Smith investigated the cause of the thickening of condensed milk. In our climate it is not unusual to find that a thickening has taken place during storage. When the tins are opened by the public, the milk may be thick, lumpy, or like a stiff jelly. The cause of this condition was traced to a micrococcus which apparently obtains access to the milk either during cooling or canning, and slowly coagulates the casein by secreting a rennet-like ferment. The small quantity of air remaining in the tin probably assists the growth of the bacterium. The microbe is easily killed, and there appears to be no reason why greater care in the later stages

of manufacture should not prevent the loss of thousands of tins of milk.

Turning to the work of the Linnean Macleay Fellows, Dr. Petrie during the past year has completed his research on the amount of arginin, histidin, and lysin in fowl's egg-white. During the process of separation of these bases, determinations of the quantity of nitrogen were made at each stage of the estimation. The figures obtained will be of value in showing the parts of the process of separation which require improvement.\*

Since the conclusion of this research, Dr. Petrie has been engaged on the application of the precipitin test to the problem of the differentiation of the vegetable species. The valuable researches of Nuttall,† Graham-Smith and others have shown that in the animal kingdom the relationships indicated by the "biological method" are those which have been accepted on the ground of morphological similarity. In the plant kingdom it was thought that this method was unlikely to be useful as the early experiments of Kowarski‡ suggested no considerable difference in the proteins of plants. Employing an antiserum prepared against extracts of the seeds of *Acacia pycnantha*, it has been found that no reaction is given with the extracts of the seeds of any plant outside the Natural Order of the Leguminosæ, to which *Acacia pycnantha* belongs. Within the group of the Leguminosæ, extracts of some seeds react with the antiserum, while extracts of seeds of other species fail to react. The plants which thus appear to be related to *Acacia pycnantha* according to the biological method show so far no general morphological similarity. It may be possible, if sufficient data be obtained, to determine the value of morphological characters and to recognise a natural grouping of plants.

The attention of Mr. E. J. Goddard, Linnean Macleay Fellow in Zoology, has been devoted to the Hirudinea, Oligochaeta, and Polyzoa. The results of his study have appeared in one article

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\* Chapman & Petrie, Journ. of Physiol., xxxix., 1909, p. 341.

† Nuttall, Blood Immunity and Relationship. Cambridge. 1904.

‡ Deutsch. med. Wochenschr. xxvii., 1902, p. 448.

on the Polyzoa and two on the Hirudinea. Two more parts on the Hirudinea are completed and await publication, while three more of the same series are far advanced and will be laid before you shortly. In addition to enlarging the anatomical and systematic knowledge of the group, Mr. Goddard has found in their metamerism fresh clues to the phylogeny of these leeches. Indeed the study of metamerism in his hands promises deductions which reach far beyond the group which first suggested them.

The Australian fresh-water annulates are now appearing as a rich fauna, and will afford new means for the solution of zoogeographical problems. Mr. Goddard's progress in these obscure groups is watched with interest by our zoological members.

Mr. Leo A. Cotton, Linnean Macleay Fellow in Geology, has now completed his first year's work. He has investigated the tin deposits of a part of the New England District, his description of which appeared in the last Part of our Proceedings. In that issue his observations in the field are presented, while his conclusions on the genesis of the deposits are reserved until a broader view shall have been obtained by a study of the whole district. During his visit he took the opportunity to investigate two interesting problems; one the Borah Creek ore deposits, and the other the occurrence and origin of the diamond deposits of Copeton. A description of the Borah Creek occurrence is now almost finished, and an account of the diamond deposits at Copeton is being prepared. Towards the end of last year, Mr. Cotton paid a short visit to the Emmaville District in New England, and intends to examine this area more closely in the near future.

On the 31st December last the total funds under the control of our Society amounted to £72,000. The amount to the credit of the Fellowships (capital) account was £38,400, and the annual income about £1,500. At the present rate of interest earned, the Society will be in a position about eight years hence to appoint a fourth Linnean Macleay Fellow—provided, of course, that there is in the meantime no sacrifice of income through difficulty in obtaining suitable investments.



Professor David entertained the Members and their friends in the geological theatre of the University at a lecture on November 10th, 1909, on the Scientific Results of the British Antarctic Expedition of 1908. A lavish display of maps, specimens, and lantern slides, supported by brief addresses on special subjects by Dr. Farr, Dr. Jensen, Dr. Woolnough, and Mr. Goddard, provided an instructive and agreeable evening.

Our association with Antarctic research has been deepened during the year by invitations accepted and fulfilled by several of our Members to contribute to the volumes published by Sir Ernest Shackleton on the Scientific Results of his Expedition.

As on the last Expedition several of our Members were honoured by a place, so we learn with pride and pleasure that on the next British Antarctic Expedition we shall be again represented, this time by our strenuous fellow Member, Mr. T. Griffith Taylor.

The Eighth International Zoological Congress will meet at Graz in Austria in August, 1910. The Committee have kindly invited this Society to send delegates, but unfortunately our distance from Europe does not allow us to attend.

There is, however, a bright prospect that three years hence we may welcome to Sydney the British Association for the Advancement of Science. At the suggestion of the Melbourne University Council, a deputation representing the Universities and learned Societies of Australia waited on the Hon. the Prime Minister on December 16th last. Our Corresponding Member, Prof. W. Baldwin Spencer, kindly acted for us on this occasion. The deputation was sympathetically received, and it is hoped that the Commonwealth, the States, and the citizens will unite in a national invitation, so that the visit of the British Association to Australia in 1913 may be as successful as that to South Africa in 1905 and that to Canada in 1909.

For the scientific portion of this Address, I have elected a subject not hitherto discussed in our Proceedings, namely,

## THE SUBMARINE SLOPE OF NEW SOUTH WALES.

(Plates i. and ii.)

(1) *The Notonectian Current.*

First we discuss the current, because without a knowledge of it the continental shelf cannot be properly understood.

Past Sydney there flows south a warm and rapid current well known to sailors and fishermen. In the days before steam it sometimes happened that inward bound ships, if becalmed off the Heads, might be carried out of sight before the wind permitted them to regain their position. Now coasting steamers trading north hug the land to avoid the stream, while southward bound vessels keep a good offing to benefit by the current in their favour.

This great current is swung in and out by the on and off shore winds, retarded and even superficially reversed or submerged by southerly gales, and accelerated by northerly winds. I am informed by Capt. W. A. Bennett, a local Government pilot, that in exceptional circumstances, after the current has been "banked up" for several days by heavy southerly gales, it may attain a maximum velocity of four knots.

Neither its origin nor its conclusion has been satisfactorily determined. Two recent maps\* give contradictory views of its course. It has been assumed, rather than proved, that this current is derived from the South Equatorial current, whose path after encountering the Melanesian Islands is indefinite. It is thought to vanish in the south of the Tasman Sea. Wilkes states that it frequently turns into Bass Strait, after which it is lost in the sea to the west of Tasmania or mingles with the Polar current. On the contrary, Hepworth† considered that this current is deflected from the Australian coast, between the 31st

\* Halligan, These Proceedings, xxxi., Pl. lili.; and Dannevig, Journ. Roy. Soc. N. S. Wales, xli., p. 43.

† Hepworth, Journ. Roy. Soc. N. S. Wales, xxxii., 1898, p. 122.

and 35th parallels, first to the east and then to the north-east by a current from the Indian Ocean passing through Bass Strait or round the south of Tasmania.

Probably the current runs south until it passes beyond the range of the north-easterly winds, whenever and wherever that may be. It is then likely to cool, to slacken and to split into diverging tongues, one of which may describe a spiral course in the Tasman Sea; the others, after encountering the opposition of Antarctic winds and currents, may finally plunge under the surface. The "Venus" appears to have felt it off the south-east of Tasmania on January 7th, 1839, in 45° 16' S. lat.\* In connection with the descending spiral, it is significant that "the isotherms of 40°, 45°, and 55° are found at greater depths on the New Zealand side" of the Tasman Sea than on the Australian.

It has been variously described as the Australian Current, the East Australian Current, and the Coastal Current of New South Wales. But as there are many Australian currents, a distinctive name would be useful. So I propose the name *NOTONECTIAN* (south swimming) to be applied to the stream running past the coast of New South Wales, without reference to its earlier or later history.

As the Gulf Stream influences western Europe, so does the Notonectian control the meteorology of our coast. The enervating climate of Sydney in midsummer is due to the warm moisture absorbed by the sea breezes from the surface of the Notonectian and immediately precipitated on the town.

Under favourable circumstances, animate or inanimate objects might drift in a couple of weeks from the tropics to Sydney. The attention of the Society has often been directed to tropical products, messages from reef and palm, cast on beaches around Sydney. In our Proceedings mention is made of punice (xxx., p.351), seeds of *Aleurites* (xx., p.210), and of *Barringtonia* (xxv., p.542), *Nautilus* shells (xviii., p.239), living Hawksbill turtles (xxii., p.254), a sea snake (xiv., p.633), *Bonellia* (xxxi., p.462), and

\* Du Petit-Thouars, Voy. Venus, Histoire iii., 1841, p.437-8.

*Pocillopora* (xxiv., pp 192, 413) drifted from the north. The dugongs on which the Blacks of Botany Bay and the Macleay River once feasted\* had a similar origin. Tropical fish which journey down the stream are cited by Waite.† Further south stranded Nautilus shells were noticed at Twofold Bay by Dr. Cox,‡ and at Flinders Island in Bass Strait by Dr. Milligan.§

The investigation of this current is the largest, most fruitful, and fascinating problem within the reach of the Sydney marine biologist.

Perhaps the first observation of the Notonectian was made by Bass and Flinders on March 25th, 1796. They stood out to sea from Port Jackson Heads, and when they steered back again towards the land in the afternoon expected to fetch Cape Solander. To their surprise they sighted Mt. Kembla instead, and realised that a strong current had carried them some twenty miles beyond their reckoning. ||

The day after leaving Sydney on his way to Cook Strait, New Zealand, Capt. Dumont D'Urville of the "Astrolabe" found on December 21, 1826, a current running to the south-east at the rate of twenty-four miles in as many hours.¶

Commodore Wilkes of the American Exploring Expedition traversed this current several times, his tender the "Peacock" observing it seventy miles off the land. He found it variable in breadth and strength, but running at certain seasons of the year with great rapidity, reminding him of the Gulf Stream. On his first arrival in Sydney in November, 1839, he found its temperature to be 73°, which on his return from the Antarctic in March, 1840, had risen to 75°.\*\*

\* Etheridge, Rec. Austr. Mus., vi., 1905, p.17.

† Waite, Mem. Austr. Mus., iv., 1899, p.16.

‡ Cox, The Nautilus, xi., 1897, p.43.

§ Proc. Roy. Soc. V. D. Land, i., 1850, p.292.

|| Flinders, Voy. Terr. Austr., i., 1814, p.xviii.

¶ D'Urville, Voy. Astrolabe, Histoire ii., 1830, p.4.

\*\* Wilkes, Narrative U. S. Explor. Exped., 1845, ii., p.362; iii., p.37; v., p.472.

Sailing out of Sydney with the "Erebus" and "Terror," in August, 1841, Sir James C. Ross was surprised to find the temperature of the surface of the sea rise from  $55^{\circ}$  in the harbour to  $63^{\circ}$  immediately outside the Heads. From subsequent observations he concluded that the breadth of the warm current running to the southward at the rate of about twenty miles a day along the coast of New South Wales does not much exceed three hundred miles.\*

We still owe the best description of the Notonectian to the "Challenger" Expedition. In June, 1874, the survey directed by Sir George Nares found the current in reduced circumstances. After a continuance of westerly winds, it was developed as a stream thirty miles broad running at an average rate of one and a half miles an hour, its inner edge twenty miles from the land. The temperature stood at  $69^{\circ}$  to  $70.7^{\circ}$ , whereas the ocean traversed by the current was only  $63^{\circ}$ . In the previous April the same expedition found the current in a more vigorous condition running close in shore with a higher temperature of  $72^{\circ}$ .†

In an interesting study of local atmospheric conditions, Mr. H. C. Dannevig has discussed this current in relation to the dispersal of fish ova. From data collected by steamers running between Sydney and New Zealand, he considered that the centre of the warm current lies normally from a hundred to a hundred and fifty miles east of Sydney. During stormy blows from the west, the current is pushed bodily seawards, but in easterly weather its western border brushes along the headlands.‡

### (2) *The Continental Shelf*

The continental shelf may be defined as that area extending outwards from the land to a depth of about one hundred fathoms. This distinction is not arbitrary, for at or about this point the sediment alters to finer and the slope of the sea-floor to steeper.

\* Ross, *Voy. Discovery Antarctic Regions*, ii., 1847, p. 5.

† Chall. Report, *Narrative*, i., 1895, p. 464.

‡ Dannevig, *Journ. Roy. Soc. N. S. Wales*, xli., 1907, p. 42.

These features indicate the approaching limit of sediment. Wherever the profile of the New South Wales coast be examined, a terrace is found to project from the beach to the hundred-fathom line, whence the ground quickly changes to a steeper grade. Compared with most other coasts, the continental shelf is here exceptionally narrow, resembling in this respect that of Western South America. Off Cape Dromedary the shelf contracts to a dozen miles, and off Newcastle it broadens to thirty-four. This narrowness of the shelf renders it impossible that extensive trawling grounds may be discovered in the waters of our State. The continental shelf of New South Wales is described and contrasted with that of Queensland by Dr. H. B. Guppy.\*

Working across the shelf with dredge or trawl, the bottom proves rough and rocky upon the shallower inshore half. Outside Sydney the projecting reefs are the favourite resort of the schnapper, and their positions are known to the fishermen by cross bearings. But in the outer portion the rocks disappear and the bottom is found to be a smooth even floor of sand and mud, a plain of sedimentation. Geologists have collected convincing evidence of recent submergence of this coast.† So that it is likely that the rough inshore part of the shelf within forty or fifty fathoms represents an old denuded land surface, including perhaps the stumps of sea cliffs of a former coast-line. In Western Europe river-beds have been traced into the Atlantic for a hundred miles beyond their present estuaries.‡ Thus we might expect to find submarine gorges crossing the Australian shelf in continuation of present valleys. But I am unable to distinguish traces of such among the soundings on the chart, and conclude that if in existence they have been obliterated by sediment. There are indeed some irregularities of the contour lines outside Port Jackson and Port Stephens, but these may result from the ebb tide eddying from those harbours.

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\* H. B. Guppy, *Journ. Vict. Inst.* xxiii., 1890, p. 59.

† David and Halligan, *Journ. Roy. Soc. N.S. Wales*, xlii., 1908 (1909), p. 229.

‡ Hull, *Trans. Victoria Institute*, xxx., 1897 (1898), p. 311.

It is now suggested that the continental shelf of this State owes its profile to the Notonectian current. A bank so regular in depth and so extensive in length must be of recent geological date. Otherwise differential crustal movements, lowering in one place and hoisting in another, would have disturbed its uniformity. It is again a fair inference to deduce that, however it is made, this bank is still in the making. Since recent depression of the coast is an accepted fact, it has been deposited since the last subsidence and an older or even a succession of shelves may lie buried beneath the present one. The sudden angle of the shelf seems to have suggested faulting to Mr. C. S. Wilkinson, who wrote: "[At] a line about 20 miles east from the precipitous coast . . . the bed of the ocean probably . . . has been faulted to a depth of over 12,000 feet."\*

On the Kosciusko Range, long wreaths of snow stretch along the eastern mountain brow through the summer and after all the rest of the winter's fall has melted away. The cause of this snow wreath is the prevailing westerly wind which sweeps off the winter's snow falling on the mountain top and drops it on the sheltered slope where it packs in a talus to a great depth. In such a manner I imagine that the current sweeps sediment along the continental shelf till it is tipped over the edge into quiet waters. A section of the bank thus formed is shown in the Ulladulla profile; the sedimentary deposit being separated from its conjectured continental base by a white line.

Neither the irregularities of the land above nor of the base beneath disturb the sweep of the 100-fathom line upon the chart. But east and south of Newcastle and Broken Bay, whence issue the Hunter and Hawkesbury Rivers, the shelf broadens considerably so that Sydney is past before the shelf retreats to its ordinary breadth. Where the shelf is carried out farther the talus slope beyond is correspondingly longer, just as would be the case in a railway embankment carried along a mountain side. Thus in the model of the coast off Sydney,

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\* Wilkinson, Notes on Geology of N. S. Wales, 1887, p. 70.

(Plates i. and ii.) the northern wall being nearer to the Hawkesbury carries the 100-fathom line five miles further seaward than does the southern. Consequently a sharper angle, a more abrupt fall occurs in the former than in the latter. All these features of the shelf accord with the hypothesis that its margin is built up by the current. In the shallower depths the rocks are swept bare of sediment: perhaps this zone even suffers erosion; deeper, I suppose, that the stream sweeps detrital matter about till on reaching the edge it is washed over into still water, there to form a talus slope. From this point of view the depth of the bank is an index to the depth of the stream, namely, a hundred fathoms. Beyond the shelf in the open sea, the current may run deeper still. As yet the current has not been plumbed by hydrographers, if we except the temperature section drawn by the Challenger Expedition. Taking the isotherm of  $65^{\circ}$  as the current boundary, their diagram (opp. p. 467) carries it down to 70 fathoms.

From eighty to three hundred fathoms according to my experience, and in four hundred fathoms according to the "Challenger" observations, there extends a deposit of glauconite sand and mud. On washing dredgings from those depths, the water is suffused with a green cloud which is slow to settle. As Dr. Flint remarks, this colouration must be due to extremely minute and amorphous particles.\* These deposits are characteristic of steep and exposed coasts like ours, where no large rivers pour out detrital matter. Probably the glauconite extends vertically from a hundred to a thousand fathoms and horizontally along the whole coast of New South Wales.

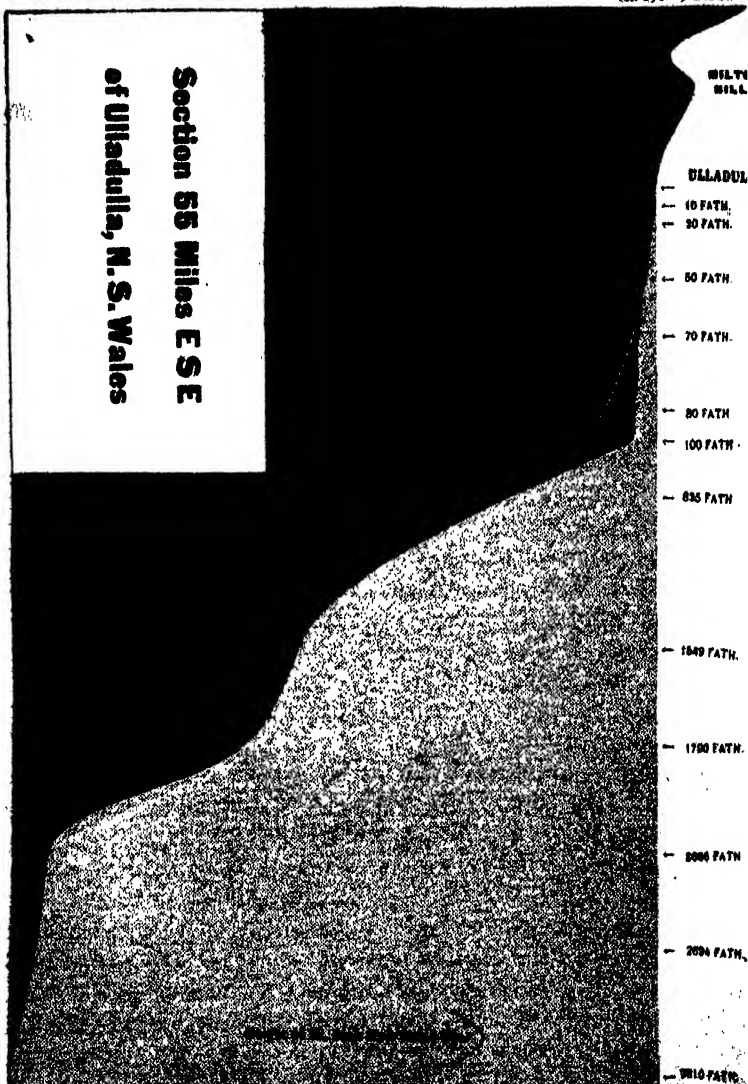
Messrs. Lee and Collet have traced out a complicated evolution for this curious marine mineral. Empty shells of foraminifera fill with clay, the alumina of which is gradually replaced by peroxide of iron, forming an internal cast. This change is indicated by the colour passing from grey to various shades of brown. Finally, glauconitisation ensues through the introduc-

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\* Flint, Bull. 55, U.S. National Museum, 1905, p. 14.



Mt. Sydney 24000



tion of potassium, converting the whole to a hydrated potassic ferric silicate, and the characteristic greenish hue is assumed.\*

### (3) *The Continental Base.*

In illustration of the slope below the shelf, here termed the continental base, a profile is selected extending seventy† miles east-south-east of Ulladulla, and produced backwards to include the coast range. Your attention is first drawn to the insignificant proportions of a lofty hill upon the left, 2,500 ft. high, compared with the depths of the ocean abyss of more than three vertical miles. As a more forcible illustration, the point is marked to where Mt. Cook, N.Z. (12,359 ft.) would reach if it could be torn from its roots and sunk in the Tasman Sea. Then note the abrupt angle of the continental shelf already discussed. Between sixteen and eighteen hundred fathoms, another irregularity occurs in the curve, which is also repeated in the model of the section off Sydney (Plates i. and ii.). This latter inflexion possibly continues the curves shown in Professor David's section across the Blue Mountains and Sydney coal field.‡ So that the Ulladulla irregularity probably represents a subfold rather than a fault or a drowned continental shelf.

Without excluding faulting as a minor agent, it is suggested that the whole sweep of the diagram portrays an earth-fold of the first magnitude; *that it represents the further wall of a pressure-trough driven by a thrust from the east*, a gigantic buckle which is bending down the whole eastern coast of Australia. If so it must be a component of a vast system. The uniform and recent subsidence which extends from Torres Strait to Tasmania is in harmony with this suggestion. For all Eastern Australia and Tasmania is to be regarded as a geographical unit. Absence of earthquakes may indicate a temporary equilibrium, but if this

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\* Collett & Lee, Proc. Roy. Soc. Edinburgh, xxvi., 1906, pp. 238-278.

† Not fifty-five, as inadvertently stated on the diagram. Mt. Sidney of the Admiralty charts is Talaterang of the Lands Department maps. Milton Hill is the north end of Kingman Range.

‡ David, Journ. Roy. Soc. N. S. Wales, xxx., 1896, Pl. ii.

movement is renewed or continued, as seems probable, then it may be the fate of the site of Sydney to sink under the sea.



Section across New Zealand, in the latitude of Mt. Cook.

Continuing the Ulladulla section eastwards across the Tasman Sea, the ocean floor rises very gradually till the South Island of New Zealand is reached. Mark how South New Zealand conforms in shape and motion to a westward rolling wave as in the above diagram. Not only does the steep face front Australia, the hogs-back slope behind and the crest advance before the centre, but the forefoot sinks under the sea in drowned land valleys and the rear rises in elevated Tertiary plains.

Again, New Caledonia may be pictured as another earth-wave of the first magnitude, rolling in upon the Australian continent. Its south-west coast, bordered by the narrowest shelf and plunging into deep water, represents the face, and the broad shelf upon which the recently elevated Loyalty Islands stand, the rear. Further north, the elevated reefs of British New Guinea are contrasted with the subsidence of the Great Australian Barrier Reef on the opposite coast. Professors Haddon, Sollas and Cole "distinctly see in Australia and its islands" . . . "the vast folds of the earth's crust roll slowly inwards upon the central continental mass."\*

This rolling wave of New Zealand is complementary to the trough of the Tasman Sea, forced down against the resistance of the continent. Thus the trough is distorted by the resistance it has encountered from the regular zeta-curve of a trough moving between rolling waves.

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\* Trans. Roy. Irish Academy, xxx., 1894 p.472.

While the subaërial crest is hacked by denudation, the submarine trough lies undisturbed. Had the upper limb remained intact, it might have reared a noble arch eighteen thousand feet high, the symmetrical counterpart of the three thousand fathom trough off Ulladulla. It was considered by Rev. W. B. Clarke that Australia and New Zealand were "separated by a synclinal curve of the rock formations forming the sea channel between them."\* But an ordinary syncline would have its maximum depth in the centre, not close to one side as it is in the Tasman Sea.

For comparison with the pressure trough, we will glance at another type of coast. The whole contour of the Great Australian Bight appears to be governed by the Jeffreys Deep, a linear depression of three thousand fathoms, whose axis nearly corresponds to the steamer track from Melbourne to Cape Leeuwin. Bass Strait, it is now suggested, may owe its origin to an extension of this furrow. Recent surveys by Mr. H. C. Dannevig on the Fisheries Investigation vessel, "Endeavour," show the sea-floor in and east of the Bight to descend from the coast in a flight of broad steps suggestive of block faulting. The western shore of the Bight extends in a wall of cliffs, truncated Tertiary beds, which may be held the topmost step, unless indeed the concentric mountain ranges of the interior be so regarded.

Below and beyond the continental shelf, the soundings off Sydney exhibit great irregularity, which, it is now suggested, may indicate a range of deep sea volcanic cones. From a study of the basaltic dykes which intrude the Triassic strata around Sydney, it appeared to Mr. G. A. Waterhouse that the radii of one system would converge to a focus about a point twenty-three miles east of Botany Heads. This focus is marked by a star under the centre of the continental shelf on Plates i. and ii. The radiation of these dykes has been thus plotted in the "Geological Sketch Map of the country in the vicinity of Sydney," Mines Department, 1903. Their occurrence shows a centre of great

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\* Clarke, Trans. Roy. Soc. N.S.W., ix., 1875, 1876, p 23.

volcanic energy to have existed thereabouts in Post-Triassic and probably Tertiary times. \*

No soundings are available about this focus of the Sydney dykes. But further out to sea, viz., 46 miles east by south from Bondi, the "Challenger" recorded a sounding (Station 164) of 960 fathoms. The position of this important sounding was accurately fixed by astronomical observations. Five miles south-west by west of Station 164 she made another sounding (Station 164A) of 1,200 fathoms. This is supported by yet another sounding, not of the "Challenger," of 1,100 fathoms, at a point 13 miles to the south-west of Station 164.

As a rule, eastwards the depth increases very rapidly, but in this exceptional case a hill actually projects some 720 feet above the level of a point several miles to the westward or shoreward of it. And as it is improbable that the "Challenger" chanced to strike on the exact summit of Station 164, the elevation of the peak may be greater still.

Since "Challenger Station 164" is an awkward and inexpressive appellation, I propose, with the permission of the Society and of Dr. Walter G. Woolnough, to name this submerged cone Mount Woolnough, after our valued fellow member

Beyond Mt. Woolnough the floor is covered with globigerina ooze, and sinks down gradually to the red mud abyssal plain. No tract of the terrestrial surface extends in so level, so monotonous an expanse as do these great abyssal plains. East from Sydney the northern end of one of these plains is traversed for about four hundred miles, after which the ground rises in a succession of undulations to New Zealand.

Prof. Milne writes, "the home of the earthquake is at the base of the steep sub-oceanic slopes where most deformation is in progress."† But our slopes have not troubled us much in this respect, telling that for the present there is a cessation of pressure movement.

Morrison, Rec. Geol. Survey, N. S. Wales, vii., 1904, p.261.

† Milne, Journ. Geogr. Soc. 1897, p.185.

The bottom temperature at 2,100 fathoms was found by the "Challenger" to be  $34.5^{\circ}$ . This probably indicates that a body of cold and heavy water, two and a half degrees above freezing, here creeps north from the Antarctic.

Looking backwards, I remind you that the Society now celebrates its thirty-fifth anniversary, and that twenty-five of such Meetings have been held in this Hall. During this existence we hope that not only have we advanced abstract science, but that we have also done the State some service in economic science. Looking forward, I conclude with the Presidential Amen

FLOREAT SOCIETAS LINNEANA !

## EXPLANATION OF PLATES I.-II.

### Plate i.

Full face view of model of the submarine slope off Sydney from Deewhy on the north to Cronulla on the south twenty-three miles, and extending east by south for sixty-six miles down to two thousand one hundred fathoms. Above is seen the entrance to Port Jackson on the right and to Botany Bay on the left. The cliffs of the coast are roughly expressed as a continuous wall three hundred feet high. Below the cliffs the sea floor is steep and broken, exposures of bare rock prevail. Beyond this again the rough bottom is buried under a nearly level expanse of sand and mud. Here the contour lines are emphasised to show bays opposite the harbour mouths and a cape running out between them. The limit of the continental shelf is determined by the steep slope reached after passing the hundred fathom line. On the right the shelf is carried out further and ends on a more sudden fall than on the left. This is associated with its proximity to the estuary of the Hawkesbury. The focus of the Sydney dykes is marked by a star. Various soundings on the Admiralty chart upon which the contours are calculated are shown by beads at 290, 650, 960, 1100 and 1200 fathoms respectively. The most important are the 960 and 1200 fathoms points on which Mount Woolnough is modelled. About this horizon the boundaries swell in an intermediate curve which may refer to other volcanoes, but is compared with a similar subfold below Ulladulla. The slope below Mt. Woolnough is gentler and continues beyond the area mapped. It is carpeted with globigerina ooze.

## Plate ii.

Another view of the same model foreshortened and seen from a lower plane to express the relation of the continental shelf to the continental base. Here the disproportion of the vertical to the horizontal scale exaggerates the steepness of the slope as seen in profile.

Mr. J. H. Campbell, Hon. Treasurer, presented the balance sheet for the year 1909, duly signed by the Auditor, Mr. F. H. Rayment, F.C.P.A., Incorporated Accountant; and he moved that it be received and adopted, which was carried unanimously. The Society's income for the year ended December 31st, 1909, was £985 18s. 9d.; the expenditure £1,065 11s. 6d.; with a credit balance of £43 19s. 5d. from the previous year, leaving a debit balance of £35 13s. 4d. The income of the Bacteriological Department was £547 6s. 8d.; and the expenditure £532 6s. 7d.; with a credit balance of £507 0s. 4d. from the previous year, leaving a credit balance of £522 0s. 5d. Macleay Fellowships' Account: the income was £1,490 13s. 6d.; and the expenditure £1,101 15s.; leaving a credit balance of £388 18s. 6d. to be carried to Capital Account.

No nomination of other Candidates having been received, the President declared the following elections for the current Session to have been duly made:—

PRESIDENT: C. Hedley, F.L.S.

MEMBERS OF COUNCIL (to fill six vacancies): R. H. Cambage, F.L.S., J. H. Campbell, H. G. Chapman, M.D., B.S., T. Storie Dixon, M.B., Ch.M., Alex. G. Hamilton, and Professor J. T. Wilson, M.B., F.R.S.

AUDITOR: [To be appointed at a Special General Meeting to be held on 3rd November, 1910.]

On the motion of Mr. W. S. Dun, seconded by Mr. J. E. Carne a very cordial vote of thanks was accorded to the President, by acclamation.

# The Ginnear Society of New South Wales.

## GENERAL ACCOUNT.

Balance Sheet at 31st December, 1909.

LIABILITIES.		ASSETS.	
	£ s. d.		£ s. d.
Capital: Amount received from Sir William Macleay during his life-time	14,000 0 0	Investments: Loan on Mortgage New South Wales Incorporated 3½% Stock	14,700 0 0
Further Sum bequeathed by his Will	5,700 0 0		5,000 0 0
£6,000, less Probate Duty, £300			19,700 0 0
	£19,700 0 0	Income A/c at 31st Dec., 1909	35 13 4
Bookbinding A/c	6 6 0		
Current A/c Commercial Banking Co.	29 7 4		
	£19,735 13 4		£19,735 13 4

Andited and found correct, and Securities produced.

F. H. RAYMENT, F.C.P.A., Incorporated Accountant.

J. H. CAMPBELL, Hon. Treasurer.

Sydney, 28th February, 1910.





**Balance Sheet at 31st December, 1909.**

**INCOME ACCOUNT, year ended 31st December, 1909.**

**Audited and found correct, and Securities produced.**

**F. H. RAYMENT, F.C.P.A., Incorporated Accountant.**

Sydney, 28th February, 1910.

**J. H. CAMPBELL, Hon. Treasurer.**

# LINNEAN MACLEAY FELLOWSHIPS' ACCOUNT

Balance Sheet at 31st December, 1909.

LIABILITIES.			ASSETS.		
	£	s. d.		£	s. d.
Capital: Amount bequeathed by Sir William Macleay, £35,000, less £1,750 Probate Duty...	33,250	0 0	Investments: Loan on Mortgage ..	33,250	0 0
Balance from Income Account capitalised in terms of bequest or available for such purpose—			New South Wales Inscribed 3 <sup>per</sup> Cent Stock...	5,000	0 0
To 31st Dec., 1908	£4,776	9 2	Cash:		38,250 0 0
On 31st Dec., 1909	388	18 6	Savings Bank of New South Wales ..		20 0 0
			Commercial Banking Co. ..		145 7 8
	5,165	7 8			
	£38,415	7 8			£38,415 7 8

INCOME ACCOUNT, year ended 31st December, 1909.				Cr.
Dr.		£	s.	d.
To Salaries of Linnean Macleay Fellows ...	1,100	0	0	
" Auditor's Fee ...	1	15	0	
" Amount transferred to Capital Account	388	18	6	

Audited and found correct, and Securities produced.

F. H. RAYMENT, F.C.P.A., Incorporated Accountant.

J. H. CAMPBELL, Hon. Treasurer.

Sydney, 28th February, 1910.

## ORDINARY MONTHLY MEETING.

MARCH 30TH, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (November 24th, 1909), amounting to 62 Vols., 304 Parts or Nos., 87 Bulletins, 12 Reports and 85 Pamphlets, received from 127 Societies, &c., and 4 Individuals, were laid upon the table.

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NOTES AND EXHIBITS.

Mr. David G. Stead exhibited three living examples of the remarkable amphibious freshwater eel, *Monopterus javanensis* Lacépède, part of a large consignment which had been imported into the State for consumption by Chinese residents, by whom this species is considered to be a great delicacy.

Mr. Carter showed a pair of specimens representing a new family of Coleoptera; tarsal formula 5-5-4, therefore, referable to the Heteromera; inhabiting ants' nests; obtained by Mr. H. Hacker in North Queensland.

Mr. Baker, on behalf of Dr. Cuthbert Hall, exhibited and offered some observations on a seedling pot-plant of *Eucalyptus oximia* with three cotyledons, the first foliage leaves, which are peltate, forming a whorl of three, instead of a pair of opposite leaves.

Mr. Fred. Turner exhibited, and offered some observations on, *Martynia fragrans* Lindl., a Mexican plant that has recently established itself in parts of the Narromine district, N.S.W.; the two long incurved hooked beaks terminating the fruit cling to any woolly or hairy substance, and pasture animals unconsciously carry them long distances and distribute the seeds far and wide. Stockowners regard this plant as a formidable new

weed pest. He had also received the fruit of *M. proboscidea* Glox., for identification, from the Young district, N.S.W., about two years ago.

Mr. T. H. Johnston showed an interesting series of Australian Entozoa, comprising—(1) *Porocephalus* sp., a linguatulid parasitic in the lung of the spinifex-snake (*Diemenia psammophis* var. *reticulata* Krft.) taken by Dr. J. B. Cleland in the north-west of West Australia: (2) *Bothridium arcuatum* Baird, a cestode inhabiting the intestine of the diamond and carpet snakes (*Python spilotes* Lacép., and var. *variegata* Gray); N.S.W.: (3) *Cytodites nudus* Viz., a small acarid taken from the mesentery of a fowl (Cleland & Johnston; Sydney), not previously recorded from Australia: (4) *Sclerostomum vulgare* Looss, from the intestine of horses in West Australia (J. B. Cleland), and N.S. Wales (T.H.J.), not previously recognised from these States: (5) *Sclerostomum edentatum* Looss, also from a horse; collected by J. B. Cleland in West Australia; not previously recorded from that State. He also recorded the occurrence of the following parasites which had not been recorded as occurring in the States mentioned after each—(6) *Spiroptera sanguinolenta* Rud., (N. S. Wales), apparently rare, occurring in tumours in the stomach of the dog: (7) *Dipylidium caninum* Linn., in cats and dogs (W. Australia; J. B. Cleland): (8) *Ascaris lumbricoides* Linn., from man (South Australia; Queensland): (9) *Ascaris megaloccephala* Cloq., from horses (Queensland): (10) *Oxyuris vermicularis* Linn., from children (Queensland; South Australia): (11) *Tænia saginata* Goeze, from human beings (Queensland; uncommon): (12) *Tænia crassicolis* Rud., from cats (West Australia): (13) *Tænia marginata* Batsch, from dogs (West Australia).

## THE SLIME OF THE HOUSEHOLD BATH-SPONGE.

By R. GREIG SMITH, D.Sc., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

*Rhizobium limosospongiae*, n.sp.

The sliming of household-sponges is a matter of common observation, and it appears to be the general idea that it is caused, in some way, by the soap used with the sponge. The explanation thus given is probably traceable to the difficulty experienced by the housekeeper in finding a more suitable explanation. Doubtless the formation of a lime-soap scum on water in basins and baths, induced the idea that a deposition of a similar substance occurs in the pores of the sponge. Probably the best means for removing the slime, without injuring the substance of the sponge too much, is to immerse it in hot, soft water, as this causes the slime to swell. The sponge is then squeezed in a cloth or towel, when the swollen slime oozes through the cloth. A repetition of this procedure will probably remove all the slime.

If one prepares and examines a stained film of the slime, one sees it is crowded with long, more or less bent, rod-like forms; and that the rods are swollen irregularly, very often with partially detached ends, characteristic of the *Rhizobium*-type of micro-organism.

When the slime was smeared upon plates of saccharose-bean-agar, the preparation of which has already been described,\* a number of colonies of slime-forming bacteria developed in the course of a few days. The great majority of them were of the *Rhizobium*-type, and the slimes varied in consistency. The

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\* These Proceedings, 1906, p. 267.

original colonies were by no means pure. Some contained *Radio-bacter*, which grows best in combination with other bacteria. Others contained *Sarcinæ* and short rods. A second smearing, followed by the usual dilution-method of plating bacteria, enabled pure cultures to be obtained. There were several kinds of *Rhizobia*, some stouter some thinner, but all produced what appeared to be a similar kind of slime. One of the organisms was taken for further work. A bacterium forming a tough slime was taken as a second microbe because it was probable that this was the cause of the slime being so adhesive to the sponge. The latter micro-organism appeared to lie midway between *Rhizobium* and *Bac. alatus* Greig-Smith.

The two bacteria were smeared upon a synthetic agar-medium containing phosphate and asparagin in combination with various sugars, etc., in order to see which sugar to use in preparing a quantity of the slime. The tough slime-bacterium refused to grow, while the other (*Bac.ii.*) produced luxuriant slimes from saccharose, levulose, and dextrose, and no slime from lactose, glycerin, dextrin, maltose or mannit. Another test was made, using bean-extract as a basis, with the same result as far as the loose slime-bacterium was concerned. The tough slime-bacterium (*Bac. i.*) produced a luxuriant slime in the presence of saccharose, levulose, glycerin, mannit and maltose, but failed to respond to lactose and dextrin.

These slimes were used to prepare films for microscopical observation. Both bacteria were Gram-negative and varied very much in size and shape, not only with regard to different sugars, but even with each sugar; and, upon the same film, great variations were seen.

With *Bacillus i.*, a smaller or larger oval shape predominated. From glycerin, the cells were comparatively small and stained deeply; from the other media, they stained diffusely. From maltose and dextrose, types similar to *Bac. alatus*\* with winged capsules were common. Levulose and mannit favoured the

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\* These Proceedings, 1905, p.570.

formation of oval cells which remained attached, in groups of three and four, as short chains, the individuals of which varied in size; and sometimes the terminal pair were at right angles to the others, thus producing a T- or Y-shape.

*Bacillus* ii. rarely exhibited the *alatus*-form. The typical cell was oval and stained terminally. Mixed with these were bent rods staining irregularly and evidently containing two, three, or four oval cells within a rod-shaped capsule. The exclamation-mark (!) form was generally seen, and in some films Y-forms were noted. It was clearly of the *Rhizobium*-type, while *Bac.* i. was evidently allied.

The respective slimes were obtained in quantity by growing *Bac.* i. on saccharose-bean-agar, and *Bac.* ii. on levulose-asparagin-agar. From these slimes, gums were prepared according to the method used in the preparation of other gums.\* The slime squeezed from the sponge was precipitated with alcohol, treated with water, and made to yield its gum in the same fashion. All the gums were tested with various reagents with the following results.

	Sponge gum.	<i>Bac.</i> i. gum.	<i>Bac.</i> ii. gum.
Alcohol.....	+	+	+
Basic lead acetate.....	+	+	+
Ammoniacal lead acetate .....	+	+	+
Neutral lead acetate.....	x	x	x
Barium hydrate.....	x	x	x
Ferric chloride.....	+	+	+
Copper sulphate.....	0	0	0
CuSO <sub>4</sub> (dil.) followed by KOH.....	+	+	+
Phosphotungstic acid.....	x	x	+
Fehling's solution.....	+	+	+
Milk of lime.....	0	0	0
Silver nitrate.....	0	0	?
Iodine.....	0	0	0
Tannic acid.....	?	?	?
Sulphuric acid.....	0	0	0
Sodium hydrate.....	0	0	0

+ = coagulation; x = a precipitate; ? = opalescence; 0 = no reaction.



These gums are similar to one another, and are probably identical. They are somewhat similar to the gum obtained from *Rhizobium leguminosarum*, excepting in one or two reactions, as, for example, Fehling's solution, with which the *Rhizobium*-gum does not coagulate. Otherwise *Rhizobium*-gum forms a jelly, while these sponge-gums form mucilages.

The bacterial gums were completely hydrolysed by boiling with 5% sulphuric acid, during which process furfural was evolved. Before and after hydrolysis, the gum of Bac. ii., which had been grown from levulose, was dextrorotatory. The solutions of the sugars, obtained after neutralising the sulphuric acid with barium carbonate and evaporating the filtrate to small bulk, were treated with phenylhydrazine-acetic acid mixture, and the impure osazones filtered off.

These were purified by the method already described,\* and found to consist of galactosazone. No other osazone could be detected, although crystalline osazone-like bodies with indefinite melting points (140° to 155°) were obtained. I have previously suggested that these are probably derived from the furfuroid or similar bodies. Upon oxidation with nitric acid the gums yielded a mixture of oxalic and mucic acids. Thus the gums were galactans.

Bac. No. i. formed a dry, rough, scaly, glistening growth on nutrient agar. In bouillon it grew scantily, chiefly as a surface ring, and the fluid remained clear; nitrates were reduced to nitrites and indol was formed. Litmus-milk was bleached, and the casein slowly peptonised, the reaction becoming alkaline, especially at the surface, where the dried casein appeared as a broad, deep blue ring. In glucose-gelatin, the growth was translucent and rough, the medium becoming slowly liquefied; the colonies were translucent and moruloid. In nutrient gelatin, the growth was similar, but there was no liquefaction. On potato there formed a transparent, flat, glistening growth which

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\* These Proceedings, 1902, p.394, and 1903, p.546.

became brownish. In Lemco-broth, with various sugars, the bacteria formed surface-rings, but there was no production of acid.

Bacillus No. ii. (*Rhizobium limosopongiae*, n.sp.) formed, on nutrient agar, a very scanty, slowly growing collection of isolated colonies, which slowly fused as a translucent, glistening, raised growth. The cells were entirely of the bacteroid type, as found in the tubercles of certain Leguminosæ. The growths in bouillon were scanty, nitrates were reduced to nitrites, and indol was formed. Litmus-milk became alkaline. The bacterium would not grow on gelatin, either glucose or nutrient. On potato, the growth was dull white, flat, and scanty. In Lemco-bouillon containing saccharose, dextrose, levulose, lactose, mannit or glycerin, surface-rings were formed, but there was no production of acid. No motility was ever observed.

While the bacteria are capable of producing slime upon the surface of certain nutritive agar media, they are apparently incapable of doing so when immersed in fluid. This was shown in an experiment in which the bacteria were grown, for three weeks, in a faintly acid solution containing asparagin(0.06 %), sodium phosphate(0.2 %), and levulose or dextrose(2 %). This nutrient fluid favoured the formation of branched forms of *Rhizobium leguminosarum*, but did not do so with these two bacteria. In the fluids, which were a centimetre deep, no slime was produced; and a similar absence of slime was noted in the cultures in Lemco-bouillon with various carbonaceous nutrients.

The condition, as regards the supply of oxygen, will be very much the same upon the surface of a damp sponge, as upon the surface of agar, while the nutrients are quite different. The question, therefore, arises, from what substance is the slime elaborated in the sponge? The solids of the water will supply the necessary saline matter, and it is conceivable that the traces of nitrogenous matter derived from the skin may be the source of the carbon. It may be the soap, but one does not expect that a sodium fatty acid salt would do this. In experiments with fluid and solid (agar) media containing asparagin and soap, no

slime was obtained. Soap\* is, therefore, out of the question as a source of slime.

The most feasible explanation is, that the substance of the sponge serves as a source both of carbon and of nitrogen. It consists chiefly of spongin, a proteid which contains 16 % of nitrogen. This is the more probable as the texture of a sponge, which has been attacked, is appreciably softer after the slime has been removed.

The activity of the bacteria in producing slime from sponge-substance, was tested by using four sponges, one of which was infected with an emulsion of Bac. i., another with Bac. ii., and a third with a mixture of both, while a fourth was reserved as a control. All were kept moist in covered beakers at 27°. In 17 days the sponge infected with Bac. ii. was a sodden, slimy mass, and had shrunk considerably. The control was unaffected, while the others were slightly slimy. The behaviour of the sponge with the mixture of bacteria, was explained by its having had a slight infection, the remains of what had not been soaked up by the first sponge. Subsequently it became much more slimy. Although the experimental sponge had been reduced in size and elasticity, there was no apparent change in the microscopical appearance of the network; the only difference noted between the infected and the control sponges was that, in the former, masses of bacteria-containing slime filled up the spaces of the sponge. The slime from the sponge contained great numbers of rod-forms, of various dimensions, and staining

\* If a slimy sponge is rubbed with soap, squeezed, and rubbed up again and again, one can obtain a condition in which the slime appears to have been removed, and the sponge behaves, to soapy water, as if no slime were in it. The slime, however, has not been removed; it has simply been coagulated, and the sponge will regain its slimy consistence on removal of the soap with changes of fresh, soft water. A sponge which is slightly slimy in hard water, becomes very slimy when soft water is used. These facts show that the slime is coagulated by soap, and by various salts. The same thing was noted when fragments of slime were inserted in nutrient bouillon; they did not swell and diffuse, but appeared to become coagulated, and remained in the medium as lumps of slime.

irregularly, like the original bacteria used for infecting. Others appeared as short, oval bacteria contained in a long, sometimes thick, sometimes thin, cylindrical capsule, the whole resembling a *Streptococcus*. Plate-cultivation showed a mixed culture of bacteria, some producing no slime, and others forming raised, compact colonies of the irregularly staining rods imbedded in a tough slime. These were similar to the infecting bacteria, although the slime was tougher.

It was evident that the growth upon the sponge had altered the character of the bacillus, to the extent of causing it to produce a more viscous slime. Further examination showed that the growth-characters had also altered. The growths upon media were much more vigorous. It now grew upon glucose and nutrient gelatin as a dull, rough layer, slowly liquefying the medium. In litmus-Lowco-gelatin with various sugars, acid and gas were produced from dextrose, saccharose, and mannit, while lactose was unaffected. A dry, yellowish layer formed on potato.

*Summary.*—The sliminess of the household-sponge is caused by slime-forming bacteria, one of which, *Rhizobium limosospongiae* n.sp., has been shown to be an active agent in producing the phenomenon.

## THE BACTERIAL FLORA OF RACHITIC STOOLS.

By R. GREIG-SMITH, D.Sc., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

Rachitis appears to be intimately associated with a disturbed condition of the normal digestive powers of the child, and is in all probability caused by badly balanced or insufficient feeding. Findlay, however, traces it to a lack of exercise such as can be brought about experimentally by confinement, and his experiments are certainly very convincing. But possibly the lack of exercise brings about a digestive disturbance, especially if it is accompanied by improper feeding, and undoubtedly some of the symptoms, *e.g.*, abdominal distension, constipation, offensive motions, point to intestinal disturbance.

This being the case, it seemed to be possible that a bacteriological examination of the stools of children suffering from the malady might show some common bacterial condition, and with this idea a few specimens of dejecta were examined. The samples were not so numerous as could have been wished for the end in view, but Rachitis is not a common disease in Australia, and a greater number could not be obtained. Still enough was done to give an indication of the nature of the bacteria generally found.

The specimens of the stools\* were received in sterilised bottles, to the wooden corks of which an iron spoon was attached. Upon its arrival at the laboratory, the sample was thoroughly mixed and a gram of material was rubbed up in a sterile glass mortar with 99 c.c. of sterile water. One c.c. of this was mixed with 99 c.c. of sterile water (=suspension i.). Two c.c. of this suspension were mixed with 98 c.c. of sterile water (=suspension ii.). Plates of media were prepared, and, after the agar had set, a diagonal was drawn across the bottom of the Petri dish with a glass pencil. A large loop of stout platinum-iridium wire (internal diameter of loop = 4.5 mm., was dipped in suspension i., and smeared over half of the plate. The loop was then pushed over

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\* For the specimens of rachitic stools and for the notes upon the cases, I am indebted to Dr. Storie Dixon.

the diagonal and the second half smeared. Thus a thick and a thin seeding were obtained. A second plate was similarly treated with suspension ii. The surface moisture was then evaporated by exposing the uncovered Petri dishes in the incubator at 37° for half-an-hour, after which the plates were covered, inverted and allowed to incubate for from 1 to 3 days, the longer time being necessary for the growth of the streptococci.

The media employed were MacConkey's lactose bile salt neutral-red agar, Endo's fuchsin agar, lactose agar or nutrient agar, with the addition of either 0.1 c.c. of normal lactic acid or 0.5 c.c. of 10% sodium carbonate per 10 c.c. nutrient agar, nutrient gelatine and glucose agar for anaërobic cultivation.

Anaërobic cultivation did not assist in isolating organisms other than those which were capable of growing aerobically. The anaërobic glucose-agar plates favoured a growth of streptococci, but these were also favoured by the aerobic-acid and especially the alkaline media. *Bac. sporogenes enteritidis* was specially sought for, but was never found. Deep tubes of glucose-agar incubated anaërobically did not reveal microbes other than those obtained aerobically upon plates, and the method was rather troublesome on account of the formation of gas bubbles and an exudation of bouillon.

The colonies that developed upon the plates were examined, and probable races and species were picked out and stroked upon agar and gelatin. The condensed water of the agar cultures was examined for the motility of the organisms, and these tests, together with the morphological appearances and reaction to the Gram stain, enabled the bacteria to be thinned down to a few possible kinds. These were purified by plating on gelatin, and presumably pure colonies were picked out and stroked on agar. From those cultures, Lemco-gelatin with various sugars, etc., litmus-milk, nitrate bouillon, etc., were infected. The non-motile organisms were frequently tested for motility.

It is possible, by pursuing certain methods of enrichment, to obtain from stools a very varied flora containing perhaps *Bac. bifidus*, or one of the bacteria grouped under the name *Bac.*

*acidophilus*; and although it is not claimed that the analysis of the bacterial flora of the stools, as given in this paper, gives a true indication of all the kinds of bacteria present, yet they are more representative than the enumeration of a number of bacteria originally present in infinitesimal proportions and isolated after enrichment in special fluid media. Preliminary experiment had shown that the growths on MacConkey's and Endo's agar were very similar to that obtained on nutrient agar or gelatin, while the special media enabled a count to be more easily made. The comparison between the media will be seen under D.S. (p. 42).

Another thing that was brought out in some preliminary experiments was, that, to have any clear idea of the flora of the stools, it would be necessary to count the various colonies upon the plates. It appeared to be useless to indicate the kinds of bacteria isolated without at the same time indicating the relative proportions in which they occurred.

Faecal Bacteria of the *coli*-type,  
positive to indol and nitrite tests, negative to Gram, gelatine not liquefied.

No.	Motility.	Gelatin growth.	Neutral red.	Dextrose.		Mannit.		Lactose.		Milk.		Saccharose.	
				Acid	Gas	Acid	Gas	Acid	Gas	Acid	Clot	Acid	Gas
B <sub>1</sub>	x	flat	x	x	x	x	x	x	x	x	x	x	x
B <sub>2</sub>	x	raised	x	x	x	x	x	x	x	x	x	x	x
B <sub>3</sub>	x	flat	-	x	x	x	x	x	x	x	x	x	x
B <sub>4</sub>	-	raised	-	x	x	x	x	x	x	x	x	x	x
B <sub>5</sub>	-	flat	x	x	x	x	x	x	x	x	x	x	x
B <sub>6</sub>	-	raised	x	x	x	x	x	x	x	x	x	x	x
B <sub>7</sub>	x	flat	-	x	x	x	x	x	x	x	x	-	-
B <sub>8</sub>	-	flat	-	x	x	x	x	x	x	x	x	-	-
B <sub>9</sub>	-	flat	x	x	x	x	x	x	x	x	x	-	-
B <sub>10</sub>	-	raised	x	x	x	x	x	x	x	x	x	-	-
B <sub>11</sub>	x	raised	-	x	x	x	x	x	x	x	x	-	x
B <sub>12</sub>	-	flat	-	x	-	x	-	x	-	x	x	x	-
B <sub>13</sub>	x	flat	x	x	-	x	-	x	-	x	x	x	-
B <sub>14</sub>	-	flat	x	x	x	x	x	-	-	-	-	-	-
B <sub>15</sub>	-	raised	x	x	x	x	x	-	-	-	-	-	-
B <sub>16</sub>	x	raised	x	x	x	x	x	-	-	-	-	-	-
B <sub>17</sub>	x	flat	x	x	x	x	x	-	-	-	-	-	-
B <sub>18</sub>	-	flat	-	x	-	x	-	-	-	-	-	-	-
B <sub>19</sub>	x	flat	x	x	x	-	-	-	-	-	-	x	x

x Positive.

- Negative reaction.

Races of *Enterococcus*.

No.	Growth on agar and gelatin.	Acid from							Nitrile.	Indol.	Neutral-red.
		Gram.	Dextrose.	Saccharose	Mannit.	Lactose.	Milk.	Milk clot.			
Str. i.	scanty.	x	x	x	—	x	x	x	—	x	—
Str. ii.	scanty.	x	x	x	x	x	x	x	—	x	—
Str. iii.	scanty.	x	x	x	x	x	x	—	—	x	x

x Positive.

— Negative reaction.

The physiological characters of the bacteria which have no action upon gelatine, which are negative to the Gram stain, which reduce nitrate to nitrite, and which form indol in peptone salt solution, differ so gradually from one another that it appears probable that they have been derived from a common type or ancestor, and have become altered by various conditions of environment. It appears to be simply a question of research to obtain all gradations from an absolutely positive to an absolutely negative race. It is therefore difficult to fix a race to any one name. The absolutely positive races are undoubtedly *Bac. coli communis*, but the absence of any one, or even more than one positive character, is not sufficient to differentiate the race, for the character may be only temporarily lost. Some work which is in progress upon the permanency of these race-characters shows that this is the case. One of the typical characters of a bacterium is its motility, but an absence of motility may have been noted in a faulty medium or at a wrong time. For example, *B.*<sub>4</sub> was non-motile at first, but after cultivation for some weeks in the laboratory, it became actively motile. It therefore appears to be a mistake to include a race under the name *Bac. coli immobilis*. The regeneration of the one character in the case of *B.* indicates that, under favourable circumstances, other negative characters may become positive.



For this reason, the races in the table have been classified as follows— $B_1$  to  $B_6$ , *Bac. coli communis*;  $B_7$  to  $B_{11}$ , atypical *coli*; and  $B_{12}$  to  $B_{19}$ , indeterminate.

The streptococci fell into three groups, called Str. i., ii., and iii., all probably races of the same organism. No. i. is of the salivary type, inasmuch as it ferments (*i.e.*, produces acid from) saccharose but not from mannit. No. ii. is *Str. acidilactici*, which, according to Sittler,\* is identical with the *Enterococcus* so frequently mentioned by writers upon the flora of infants' stools.

The following are the analyses of the stools, the numbers of bacteria being expressed in percentages. The notes are by Dr. Storie Dixon (Infants' Hospital):—

A.J., aged 12 weeks. Incipient Rickets.

MacConkey's medium	...	$B_2$ , 100
Endo's medium	...	$B_2$ , 20; Str. i. and ii., 80
Acid agar	...	$B_3$ , 95; <i>Micr. candidus</i> , 5
Alkaline agar	...	} Str. ii., 100
Glucose-agar (anaërobic)	...	
Acidity of stool	...	1 grm. = 0.6 c.c. $\frac{N}{10}$ acid
Typical bacterium = <i>Bac. coli communis</i> .		
Typical streptococcus = Str. ii.		

Notes.—Outpatient, incipient rickets, only came once. 11/8/09.

H.M., aged 1 year and 8 months. Convalescent from acute Rickets.

MacConkey's medium	...	} $B_1$ , 100
Endo's medium	...	
Acid agar	..	
Alkaline agar	...	} Str. iii, 100
Glucose-agar (anaërobic)	...	
Acidity of stool	...	1 grm. = 1.5 c.c. $\frac{N}{10}$ acid (very acid with strong faecal smell) *

\*Centrl. für Bakt. Orig. 47, 18.

Typical bacterium = *Bac. coli communis*.

Typical streptococcus = Str. iii.

Notes.—Outpatient, came for treatment on 6/5/09, very characteristic shape of head, severe vomiting and diarrhoea, motion sent 19/8/09. At 17 months of age anterior fontanelle was over  $\frac{1}{4}$  inch wide at widest part.

L.S., aged 11 months.

MacConkey's medium	...	B <sub>a</sub> , 100
Endo's medium	...	B <sub>a</sub> , 30; B <sub>1s</sub> , 5; Str. iii., 65
Acid lactose-agar	...	B <sub>a</sub> , 15; Str. iii., 85
Alkaline agar	...	} Str. iii., 100
Glucose-agar (anaërobic)	...	
Acidity of stool	...	1 grm. = 0.1 c.c. $\frac{N}{10}$ acid

Typical bacterium = *Bac. coli communis (immobilis)*.  
 Typical streptococcus = Str. iii.

Notes.—Inpatient, admitted 28/7/09, motion sent 19/10/09. Indications of rickets only slight.

V.B., aged 1 year and 8 months. Convalescent from slight Rickets.

MacConkey's medium	...	B <sub>12</sub> , 90; B <sub>14</sub> , 10
Endo's medium	...	B <sub>12</sub> , 19; B <sub>14</sub> , 1; Str. i., 80
Acid lactose-agar	...	B <sub>14</sub> , 20; Str. i., 80
Alkaline glucose-agar	...	Str. i., 100
Acidity of stool	...	1 grm. = 0.3 c.c. $\frac{N}{10}$ acid

Typical bacterium = indeterminate.  
 Typical streptococcus = Str. i.

Notes : —Inpatient admitted 23/3/09, motion sent 19/10/09. Symptoms of rickets only slight.

M.E., aged 1 year and 2 months. Convalescent from acute Rickets.

MacConkey's medium	...	B <sub>7</sub> , 100
Endo's medium	...	B <sub>7</sub> , 88; Str. i., 12
Acid lactose-agar	...	B <sub>7</sub> , 100
Alkaline agar	...	} Str. i., 100
Glucose agar (anaërobic)	...	

Acidity of stool ... 1 grm. = 0.4 c.c.  $\frac{N}{10}$  acid

Typical bacterium = atypical *coli*.

Typical streptococcus = Str. i.

NOTES:—Outpatient, first treated 23/3/09, severe rickets, motion sent 18/8/09, by which time the severe sweats, pallor and diarrhoea had long disappeared. Though now 14 months old, was only beginning to cut its teeth (six appearing almost simultaneously). A brother, 4 years of age, had a very characteristic form of head, and the other children of a family of six had all died early in life.

D. S., aged 9 months. Pronounced Rickets.

MacConkey's medium ... B<sub>7</sub>, 70; B<sub>19</sub>, 30

Endo's medium ... B<sub>7</sub>, 85; B<sub>19</sub>, 12; *Bac. vulgaris*, 3

Acid lactose-agar ... B<sub>19</sub>, 86; B<sub>7</sub>, 14

Nutrient agar ... B<sub>19</sub>, 28; B<sub>7</sub>, 12; Str. iii., 60

Alkaline lactose agar ... Str. ii., 25; Str. iii., 75

Glucose-agar (anaërobic) ... B<sub>19</sub>, 30; *Bac. vulgaris*, 5; Str. ii., 65

Acidity of stool ... 1 grm. = 0.3 c.c.  $\frac{N}{10}$  acid

Typical bacterium = indeterminate: *coli (immobilis)* : : 3 : 2

Typical streptococcus = Str. iii.

D.S. : three days later.

MacConkey's medium ... B<sub>13</sub>, 100

Endo's medium ... B<sub>13</sub>, 98; B<sub>18</sub>, 2

Acid lactose-agar ... B<sub>13</sub>, 50; Str. iii., 50

Nutrient agar ... B<sub>13</sub>, 94, Str. iii., 6

Alkaline lactose-agar ... B<sub>13</sub>, 50; Str. ii., 50

Nutrient gelatin ... B<sub>13</sub>, 100

Enriched in glucose-bile salt bouillon (anaërobic) then

Endo's medium ... B<sub>1</sub>, 50; B<sub>18</sub>, 50

Nutrient agar ... B<sub>1</sub>, 98; B<sub>8</sub>, 2

Acidity of stool ... 1 grm. = 0.4 c.c.  $\frac{N}{10}$  acid

Typical bacterium = indeterminate.

Typical streptococcus = Str. iii.

NOTES:—Inpatient, admitted 30/8/09, motions sent 1/9/09 and 4/9/09. Very characteristically shaped head, motions brown and relaxed, but though these rapidly lost their relaxed nature, they remained browner than usual in infants.

This is the only case where very pronounced rickets was present when the motion was sent and the patient only just beginning to be treated.

All the above infants had the characteristic head, and though two were only mild cases, the others had been fairly severe.

The bacterial flora of these stools is varied, but the relative preponderance of *Bac. coli communis* in some of the stools, and especially in the case of the infant of twelve weeks (A.J.), raised the suspicion that a *coli*-intoxication may have some influence one way or another, either in establishing or accelerating the disease. The examination, however, of stools from healthy children showed that this was not the case, as in these, the races of the *coli*-group were well represented.

The analyses of the stools of a few healthy children are as follows:—

P. H., aged 15 months.

MacConkey's medium	...	B <sub>5</sub> , 95; B <sub>17</sub> , 5
Endo's medium	...	B <sub>3</sub> , 90; B <sub>5</sub> , 5; B <sub>10</sub> , 5
Acid lactose-agar	...	B <sub>5</sub> , 100
Alkaline lactose-agar	...	No growth
Nutrient agar	...	B <sub>5</sub> , 100
Acidity of stool	...	1 grm.=neutral
Typical bacterium= <i>Bac. coli communis</i> ( <i>immobilis</i> ).		
Typical streptococcus=none.		

A. T., aged 10 months.

MacConkey's medium	...	B <sub>1</sub> ,* 100
Endo's medium	...	B <sub>1</sub> , 50; B <sub>10</sub> , 50
Acid lactose-agar	...	B <sub>10</sub> , 63; B <sub>11</sub> , 7; Str. ii., 30
Alkaline lactose-agar	...	Str. ii., 100
Nutrient agar	...	B <sub>10</sub> , 40; Str. ii., 60
Acidity	...	Neutral
Typical bacterium= <i>Bac. coli communis</i> .		
Typical streptococcus=Str. ii.		

\*It is evident that B<sub>1</sub> was indistinguishable from B<sub>10</sub> on MacConkey's medium and nutrient agar, both of which probably contained a mixture of the two races. This mixture is shown on Endo's medium.

A. W., aged 14 months.

MacConkey's medium	...	}	$B_{25}$ , 100
Endo's medium	...		
Acid lactose-agar	...		
Nutrient agar	...		
Alkaline lactose-agar	...		White sarcina, 100
Acidity	...		Neutral

Typical bacterium=atypical *coli* : *Bac. coli communis* : : 5 : 3  
 Typical streptococcus=none.

S. B., aged 5 months.

MacConkey's medium	...	$B_{25}$ , 98; $B_{24}$ , 2
Endo's medium	...	$B_{25}$ , 100
Acid lactose-agar	...	$B_{25}$ , 98; $B_{24}$ , 2
Alkaline lactose agar	...	No growth
Nutrient agar	...	$B_{25}$ , 100
Acidity	...	1 grm.=0.4 c.c. $\frac{N}{10}$ acid

Typical bacterium=*Bac. coli communis* (*immobilis*).

Typical streptococcus=none.

The analyses show that the flora of the dejecta of normal children is very much the same as that of the children affected with rickets, so far as the bacteria of the *coli*-group are concerned. But there is a difference in the comparative absence of the streptococci.

These were rather conspicuous in the stools of the cases of rickets, growing even on Endo's medium, and thus in the analyses they were prominently brought before one. Such was not the case with the normal children, and indeed it is with regard to the streptococci that any difference can be found between the diseased and the healthy condition.

According to Tissier,\* the *Enterococcus*, the chief streptococcus of the rachitic stools, can withstand an acidity of from 2 to 2.45, while *Bac. coli* succumbs when 1.73 is reached. From this we infer that it is capable of producing a relatively greater

\* Annales de l'Institut Pasteur 19, 109.

amount of acid. In the duodenum and upper parts of the intestine of normal children the contents are slightly acid and contain coccal forms almost to the exclusion of the rod forms. Further and further down the tract, the bacilli become more and more evident until, in the rectum, the cocci are comparatively rare and the rod forms predominate (Tissier). This is rather important, and is in agreement with the bacteriological analyses of the healthy stools, in the majority of which no streptococci were found. The fact that streptococci are more in evidence in the stools of rachitic children shows that they persist for a greater distance down the tract and that they are in relatively greater numbers all along the canal. Their greater numbers indicate a more acid condition of the intestinal contents, but it is difficult to say whether they are the cause or the effect. Probably a vicious cycle has been set up.

The rod bacteria thrive well upon sugar-free media, such as nutrient agar, while the streptococci grow better upon saccharine media, and form very scanty growths in media devoid of sugar. This appears to show that in cases of rickets in which streptococci predominate, the sugar derived from the food is in excess, and the proteid is deficient in the intestinal contents. This is in agreement with the experience of medical practitioners who, in treating cases of rickets, prescribe an alteration of the diet, increasing the proteids and the fat, and diminishing the carbohydrates. The effect of the increased proteid would be to increase the relative number of the *coli*-bacteria, while the diminution of the carbohydrate would further accentuate the difference by decreasing the streptococci. The increased fat would supply the necessary energy and heat, and at the same time offer a less favourable pabulum for the growth of the streptococci.

The case in favour of the streptococci being associated with the disease is not, however, absolutely clear. Their occurrence in the convalescent cases may weaken the argument. It is true that in two of the stools they were of the salivary type, but the third contained Str. iii., which was the typical race in the instance

of pronounced rickets. There is also the occurrence of Str. ii. in one of the normal stools.

It is probable that, as in all other biological phenomena, we must take into account the idiosyncrasy of the individual, some being able to tolerate a relative excess of streptococci while others cannot.

On the whole, there is some reason for believing that the occurrence of a preponderance of streptococci in the stools of rachitic children is associated with the disease.

## WEDNESDAY, APRIL 27TH, 1910.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, April 27th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

Mr. A. S. LE SOUËF, C.M.Z.S., &c., Zoological Gardens, Sydney, and Dr. ROBERT HENRY PULLEINE, Adelaide, S.A., were elected Ordinary Members of the Society.

In taking farewell of Mr. E. J. Goddard, B.A., B.Sc., on his retirement from a Linnean Macleay Fellowship, to fill the position of Professor of Zoology and Geology at Victoria College, Stellenbosch, South Africa, the President, on the Society's behalf, tendered to Mr. Goddard hearty congratulations on his appointment, and all good wishes for his success in his new sphere of work. As Mr. Goddard hoped to continue and extend his work on freshwater Annulates, he would still be glad to be supplied with Australian specimens.

The President offered the Society's congratulations to Dr. H. G. Chapman, to whom the Syme Prize for 1910, for the encouragement of Research Work in Natural Science, had recently been awarded by the University of Melbourne.

The President made reference to the recent death of Mr. F. W. Petterd, of Launceston, a Member of the Society, and also a member of the Chevert Expedition to New Guinea, in 1875.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 20 Vols., 58 Parts or Nos., 33 Bulletins, 1 Report and 18 Pamphlets, 1 Map, received from 50 Societies, &c., and 2 Individuals, were laid upon the table.



## NOTES AND EXHIBITS.

Mr. Cheel showed fruits of tomato (*Lycopersicum esculentum*), infested with the Sleeping Disease (*Fusarium lycopersici* Sacc.), found at Penshurst. Cases of this disease were previously found at Gosford in December, 1899, by Mr. Froggatt, and afterwards by the late Mr. A. Grant among plants growing in the Botanic Gardens, Sydney, in February and April, 1903. In Great Britain, according to Mr. Massee, the disease causes very great damage to tomato-crops.

Mr. Tillyard exhibited a larva of *Synthemis eustalaeta* Burm., (NEUROPTERA: Odonata) which had been without food for three months, and had been subjected to gradual drought-conditions culminating in three weeks of complete absence of water. The insect was still alive and quite healthy. Three others, though apparently lifeless when first examined, quickly revived when dropped into water. This seemed to be the first absolute proof of the ability of any dragonfly larva to stand a complete drought.

Mr. T. H. Johnston showed a fine specimen of a tomato affected by the Irish Blight-fungus (*Phytophthora infestans*). The exhibit was grown in the Sydney district. Though it is well known that tomatoes are susceptible to this potato-disease, infected fruits are very seldom met with, though tomato-plants may be growing side by side with potatoes which are badly blighted.

Mr. Fred Turner exhibited, and offered observations on, two species of *Chenopodiaceæ*, viz., *Anisacantha divaricata* R.Br., and *Sclerolana bicornis* Lindl., from the Brewarrina district, New South Wales. On one pastoral holding three years ago only a few scattered shrubs of the former were to be found; now they were to be seen covering an area of twenty-five thousand (25,000) acres to the

exclusion of almost any other plant. Some few years ago, when botanising near Blacktown, with the late Honorable Dr. James Norton, M.L.C., he found two plants of *Anisacantha divaricata* R.Br.; but there was no doubt that the seeds had been brought from the western country in railway trucks that conveyed sheep to the Riverstone meat-works. As far as he was aware, that was the first time this species had been found growing on the eastern side of the Dividing Range. In the interior stockmen call the spiny fruits of various species of *Anisacantha* "bindy-hies," which are often a terror to those who camp out. *Sclerolana bicornis* Lindl., had spread very much during recent years in some parts of the Brewarrina district. This plant is disliked by pastoralists on account of its spiny fruits. Some varieties of this species have strong, and very sharp spines more than half an inch long.

Mr. Fletcher asked if any Member could furnish him with references to scientific records of the occurrence of freshwater eels in the creeks of Norfolk Island, as he had been unable to ascertain that ichthyologists had had the opportunity of examining specimens from this locality. Nevertheless Lieutenant King, who commanded the party which first colonised the island, both in his "Description of Norfolk Island,"\* and in his Journal,† speaks definitely about them. As the common freshwater eel (*Anguilla australis* Rich.) had been recorded from Lord Howe Island (Australian Museum Memoirs No.2, pp.20 and 72), it was worth investigating whether conditions at Norfolk Island had

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\* "The island is well supplied with many streams of very fine water, many of which are sufficiently large to turn any number of mills. These springs are full of very large eels." [Description of Norfolk Island, by Lieut.-Governor King, 10th January, 1791. Historical Records, Vol. i., Part 2, p 429].

† "The island is well supplied with many streams of very fine water, some of which are sufficiently large to run any number of mills: it is probable that most of these rivulets originate from springs near Mount Pitt. . . . All these streams abound with very fine eels." [Lieut. King's Journal, in Hunter's Historical Journal, 1793, p.389].

altered, resulting in the disappearance of the eels, or whether they were still to be met with. •

The Secretary intimated that, at the next Meeting, he proposed to initiate discussion upon the application of Jordan's Law, or the Law of Geminate Species, to the case of the Australian fauna and flora---"Given any species, in any region, the nearest related species is not to be found in the same region nor in a remote region, but in a neighbouring district separated from the first by a barrier of some sort or at least by a belt of country, the breadth of which gives the effect of a barrier." Members were asked to furnish examples of geminate species, and to throw light upon the character of the barriers which prevail.

CONTRIBUTION TO A KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*. PART V. LEECH-METAMERISM.

By E. J. GODDARD, B.A., B.Sc., LINNEAN MACLEAY FELLOW OF THE SOCIETY IN ZOOLOGY.

(Plate iii.)

The subject of "Metamerism in the Hirudinea" has for a long time attracted the attention of workers on the group. It has long been known that the annuli which appear on the surface of the leech do not represent true segments or metameres, but that in each genus more or less typically a certain number represent conjointly the limits of a somite. The number of annuli thus entering into the constitution of a somite is, as a rule, constant fundamentally in each genus, although in connection with the extension of the somite variations may take place in the various species of a genus. This, however, happens in but few genera in comparison with the number in which the number of annuli entering into the formation of the "unabbreviated" somites is constant, and characteristic of the genus. At either extremity of the body are found "abbreviated" somites, that is, segments which do not comprise the full number of annuli as found entering into the formation of the complete somite which is present in the middle region of the body. These "abbreviated" somites, when their exact limits have been carefully mapped out, throw much light on the mode of formation and order of origin of the annuli, as we pass from the hypothetical primitive and unannulate condition of the somite. For our present day conception of the limit of the somite we are indebted mainly to Castle and Moore.

From a study of the nervous system it is evident that 34 somites are represented potentially in the body of all members of the *Hirudinea*, the number of these visible on external examination of the leech being always much less. In the ventral nerve-chain lie 21 distinct, normal, ganglionic masses, and in addition at either extremity lies a much swollen ganglionic mass. These latter terminal aggregations of the ventral chain represent the fused ganglia of 13 somites, of which those represented in the anterior terminal mass are represented externally as "abbreviated" somites at the anterior extremity of the body. The somites denoted by the capsules of the posterior terminal ganglionic mass are not represented externally on the body as segments. From this we can conclude that the missing somites of the posterior extremity are represented in all the various groups of the *Hirudinea* by the posterior sucker; and, furthermore, that in the *Ichthyobdellidae* a number of the anterior somites are represented in the "capula." In support of this it may be stated that the posterior sucker often shows a faint annulation, and the same is often to be noted in connection with the capula of the *Ichthyobdellidae*. Again, it is only by this means that we can make the position of the genital apertures in the *Ichthyobdellidae* coincide within somite-limits with that found in the *Glossiphoniidae*, *Gnathobdellidae*, and *Herpobdellidae*, inasmuch as the genital apertures in the *Ichthyobdellidae* are more anteriorly situated, if one reckons from the first visible annulus behind the capula.

If we are to regard the *Hirudinea* as having been descended from an Oligochaetan stock, we must regard the ancestral form as a uniannulate worm whose body consisted of 34 distinct somites. More will be said in reference to this after the description of the somitic constitution of a number of forms which I have had the opportunity of examining.

In a study of various genera in which the number of annuli entering into the constitution of a typical somite is different, one has some opportunity of deciding definitely the order of origin of

the annuli, and the significance of the same as bearing on the generic importance of that annulation. In my studies in this connection I have assumed the uniannulate condition as being the primitive one, and in this subject for consideration the question is raised as to which annulus of the somite represents potentially that hypothetical primitive ring.

In many leeches there occur, on special annuli, certain sensory papillæ which are more important and prominent than any others which may be developed on the remaining annuli, and these papillæ serve as an indication of the somite-arrangement and constitution. Among other externals which are of the same assistance may be mentioned the nephridiopores, whose position relative to that of the main sensory papillæ is constant. It was only natural that these two structures should have been taken by earlier workers as external signs of the metamerism, as it was readily corroborated by a study of the central nervous system; and it can be readily understood that Whitman should have assumed that the annulus bearing the sensory papillæ represented the first ring of a somite (this annulus carrying also the nerve ganglia), and that the nephridial aperture lay in the last annulus of the somite. Whitman's idea in this connection was upheld until Castle, in 1900, came to the conclusion, from a detailed study of the nervous system, that the limits of a somite were to be recognised from a knowledge of the neuromerism, and from a study of this he came to the conclusion that the sensory annulus represented in general not the first but the middle or potentially middle annulus of the somite. He has further worked out the order of abbreviation, etc., at either end of the body, pointing out that the sensory ring was the most stable of the component annuli of the somite, and that the other annuli were in the first place derived from this sensory annulus by divisions of it anteriorly and posteriorly.

Castle's conclusions have, in the main, been supported very strongly by Livanow's excellent detailed work on the nervous system.

In view of the results obtained by these workers, the opinion of present day students must be that the sensory annulus denotes the middle or potentially middle annulus of the somite.

I have had occasion, in mapping out the somitic constitution of various Australasian representatives of the group, to test Whitman's and Castle's methods of determining somite-limits, and the conclusions are interesting in that they show that considerable variation takes place in various genera regarding the manner of origin of the annuli; and that, while Castle's conclusions are found to be correct in the greater number, in other forms there is a great divergence from the conditions which obtain in the former. From a study of these, the importance of the somitic constitution as a generic character has been found to depend on the manner of the origin of the annuli.

*Limnobdella australis*.—This leech, for all practical purposes as far as this discussion is concerned, may be considered as belonging to the genus *Hirudo*, inasmuch as it has the same number of annuli, same pentannulate somite, position for the eyes and genital apertures, same number and position of nephridiopores, and the general anatomy is very closely related. Consequently, we can safely conclude that it has the same somitic constitution throughout as in those forms which would fall within the limits of the genus *Hirudo* in its more narrowed sense. In this way we can derive assistance in the study of the metamerism of *Limnobdella australis*, inasmuch as we find metameric sense-papillæ very well developed in such forms as *Hirudo medicinalis*, and one can most legitimately use the position of these structures as if they were present in *L. australis* itself. What is now to be stated in connection with the metamerism of *L. australis* applies equally well to all species of the *Hirudinea* which would fall within the limits of the diagnostic characters of *Hirudo* in its wider sense; that is, all species which possess 102 annuli, and have the eyes situated on annuli 1, 2, 3, 5, and 8, and the genital apertures situated in annuli 30, 35, and 36 respectively.

According to Whitman's scheme and Castle's scheme respectively, we find the metamerism of the anterior extremity to be as follows:—

Somite.	Annuli(Whitman).	Annuli(Castle).
i.	1	1
ii.	2	2
iii.	3, 4	3, 4
iv.	5, 6, 7	5, 6
v.	8, 9, 10	7, 8, 9
vi.	11, 12, 13	10, 11, 12
vii.	14, 15, 16, 17, 18	13, 14, 15, 16
viii.	19, 20, 21, 22, 23	17, 18, 19, 20, 21

It is now regarded by most workers on the group that the somite consisting of a few annuli is more primitive than that which is multiannulate, and with this view I am in accord. This view is then, in effect, that annulation of the segment is a secondary character. Consequently when we find two annuli intimately fused we must regard this state of affairs as the result of an incomplete differentiation and not of abbreviation.

Now we find in *L. australis* that annuli 5, 6, and 7, 8 are well differentiated from each other respectively on the dorsal side, but they are fused ventrally. This shows clearly that 5 and 6 belong to one and the same somite, 7 and 8 to another somite. This being so, it must then be concluded that the sense-papillæ represented by the eyes situated on annulus 8 do not lie on the first annulus of the somite. If Whitman's scheme applied in this case, then we should have the absurdity of an annulus in one somite originating from that in another somite. In the table given above, I consider the annuli as distributed according to Castle's scheme to be the correct one. On the assumption that, at the extremities, we find the somite developing through the same stages through which the pentannulate somite passed, and that no "fusion" has taken place at all, we find that somite iv. consists of two annuli of which the first is sensory; the second annulus has arisen posterior to this annulus, but, inasmuch as it



is still fused with it ventrally, the differentiation is not yet complete. In somite v., we find there are three annuli, the middle one of which is the sensory annulus; the posterior ring of the somite is quite distinct dorsally and ventrally from the sensory ring, but the anterior annulus is still fused ventrally with, or rather not yet differentiated from, the sensory ring. Passing now to somite vi., we find the segment consisting still of three annuli, all distinct from each other. In somite vii., there are four annuli, the sensory ring being placed second; and in somite viii., we find the first complete number of annuli.

From these facts it will be seen that we have a complete series showing the development from the uniannulate somite of the extremity of the body to that which is pentannulate; and in *L. australis* we get clearly the order of development of the annuli in the somite, a fact which is most important in connection with the condition of the complete somite. It will be seen, from the facts stated above, that the sensory annulus gives rise by division to another annulus posteriorly, later another anteriorly; then a fourth develops at the posterior extremity of the somite, and finally a fifth annulus at the anterior extremity. This is exactly in keeping with the ideas of Whitman, Bristol, and Castle in this direction.

*Orobdella*.—This Japanese genus is represented by three species of which *O. Whitmani* is tetrannulate, *O. Ijimai* has six, and *O. octonaria* has eight annuli entering into the formation of the "unabbreviated" somite. We may reasonably regard *O. Whitmani* as exhibiting the most primitive condition as regards the constitution of the somite for the genus. As it has been shown, in the case of *Philomon*, *Pontobdella*, and *Ozobranchus*, that the sensory annulus represents the third ring of the adult tetrannulate somite, we may, with every reason, conclude that the same holds in *O. Whitmani*. This means that in this species the ganglion of the ventral chain in the middle region of the body is found in the third annulus of the somite, and the nephridiopores on the posterior margin of the second annulus.

Considering now the three species of *Orobdella* from this standpoint, and examining the genital region, we find that the male genital pore in the species is situated in reference to the sensory annulus as follows :—

*O. Whitmani* in 2nd annulus anterior to ganglion.

*O. Ijimai* in 3rd       "       "       "

*O. octonaria* in 4th       "       "       "

The nephridiopores are situated in *O. Whitmani* and *O. Ijimai* on the posterior margin of the annulus preceding that in which the ganglion lies. In the case of *O. octonaria* the ganglia lie in two annuli, and the nephridiopores on the posterior margin of the annulus preceding the more anterior of these two annuli, so that we may conclude that the same two annuli represent the sensory annulus of *O. Whitmani* and *O. Ijimai*, and further that the nephridiopores occupy the same relative position as in the latter two species. Again, from the fact that the ganglion is so situated in *O. octonaria*, we may conclude from comparison with the other two species that the sensory annulus remained quite stable as regards somite-extension or increased annulation in the passage of the somite from the tetrannulate condition of *O. Whitmani* to that exemplified in *O. Ijimai* with its somite composed of six annuli. Later, however, in the passage to the condition of the somite composed of eight annuli this sensory annulus underwent division as shown in the manner above described in *O. octonaria*. In the diagram shown in illustration of this I have attempted to map out the order of origin of the annuli. Somite-extension more readily affects the extreme annuli of the somite, and we find that the anterior and posterior annuli of the tetrannulate somite have divided to give rise to the somite of six annuli. One may prove this by stating that, in the *Hirudinea* in general, the terminal annuli are more prone to divide; that, further, the sensory annulus, for reasons given above, appears not to have been concerned in this stage; that the genital aperture lies in the third annulus in front of the ganglion in *O. Ijimai* instead of being found in the second annulus reckoned in

the same way in *O. Whitmani*, thus proving that another annulus has been added in front of the sensory annulus, and this could have taken place only by division of annulus 1, and not of annulus 2; that another annulus has been added at the posterior region, and only annulus 4 could have been concerned in this. In considering the passage now from the somite of six annuli to that of eight annuli we find, as shown above, that the sensory annulus has divided, and that no further annulus has been added posteriorly. The only point to consider now is whether 1a, 1b, or 2 has divided to give rise to the extra annulus anterior to the ganglion. As the sensory ring is usually so stable, but has been proved to divide in this case, it would seem very probable that a division has taken place in 2 also. The order of appearance of these annuli would then appear to be as shown in the diagrams illustrating the constitution of these species. (Plate iii., figs. 1A, 1B, 1C.)

*Pontobdella macrothela* Schmarda.—The specimen of this species which I had the opportunity of examining, offered special interest for the study of the somite in that genus, inasmuch as the limits of the somite are very clearly shown on external examination without entailing any reference to papillæ, etc. In this species the somite is triannulate, and the annuli constituting the somite consist of one very wide, and two equally small. The annuli are found to be arranged so that the large ring is very intimately bound up with a small one anterior to it, and another posteriorly situated. The line of division between any two small annuli is denoted by a very strongly marked groove so clearly that, on a very casual glance, one could easily determine the limits of a somite without reference to papillæ. The annuli are all provided with prominences, but, in the case of the large annuli, the arrangement and importance of development are quite different. It is this large annulus which corresponds to the large papilliferous annuli of other species of *Pontobdella*, such as *P. australiensis* and *P. muricata*. The only abbreviated somites to be noted occur towards the posterior extremity, and here it is found that a biannulate somite is represented by a

large anterior annulus (sensory), and a small posterior annulus. This constitution for a biannulate somite is by far the commoner in all members of the *Hirudinea*.

In some cases the somite of *Pontobdella* consists of four annuli, and then, says Castle, "Apparently, however, it is at the anterior end, for in these animals which I have had an opportunity to examine, the new ring appears to be united more closely with the ring which precedes than with that which follows a sensory ring. Moreover the ring which precedes the sensory ring is usually not so broad as the one which follows it. This is an indication that it is the former rather than the latter which has undergone division." I have not yet had the opportunity of examining a species of *Pontobdella* in which the somite consists of four annuli, but Castle's observations show very clearly that in such forms the third annulus is the sensory ring.

*Ozobranchus branchiatus*.—Lately I have had the opportunity of examining specimens of this form, and, inasmuch as the species has not been noticed and examined in detail since Menzies described it in 1791, the metamerism of such a species, since the nature of the leech-body morphologically has been variously interpreted since that time, should offer some little interest.

In the "neck"-region of the young individual eight distinct somites can be made out, and, judging from the intimacy of the connection of the annuli, the limits of a somite are clearly marked off. Each somite consists of an anterior annulus which is twice the size of a posterior small annulus. In most instances, also, but particularly in the posterior region of the "neck," there is a more than faint indication of division in the large anterior annulus, so that the somite is foreshadowed in its triannulate condition. This fact shows that the large anterior annulus represents within itself potentially the original primitive annulus of the uniannulate somite; further, that the posterior annulus of the somite is formed and definitely differentiated before traces of the anterior annulus can be made out; and, again, the middle annulus of the triannulate somite represents the primitive ring. This is in keeping with what is to be observed in most cases in

regard to the order of development of annuli towards the constitution of a triannulate somite, namely, that the annuli are developed alternately posteriorly and anteriorly to the sensory annulus. The anterior extremity, or "head," although not forming a distinct "capula" as in other *Ichthyobdellids*, represents a number of fused annuli or somites whose lines of division are not shown externally on the body-surface, beyond that the margin of the "head" is furrowed as far as the midline.

*Semilageneta Hilli*.—In my original description of this genus I pointed out that the somite was triannulate, and that the limits of the somites were denoted in the anterior part of the body by the presence of distinct papillæ, and in the remaining body-portion by the outline of the body which was divided into segmental regions, consisting of three annuli, by well marked sulci. These areas I still consider to represent distinct somitic divisions. Passing forwards from xii., which is the first of the somites thus marked off, we find xi. triannulate and carrying papillæ on the first and not on the second or middle annulus. This distribution of the papillæ then agrees with Whitman's plan, and not with that of Castle.

*Addendum to original description*.—I originally placed *Semilageneta* among the *Glossiphoniids*, but, judging from the position of the genital aperture, it should find its place among the *Ichthyobdellids*. The nature of the anterior extremity, however, is distinctly intermediate between that found in the *Ichthyobdellids* and *Glossiphoniids*, there being no capula developed as in the former of these two groups.

*Phlebotomus pungens*.—In examining some killed specimens of this species, my attention was attracted to a regular separation of groups of annuli on the ventral surface, and, strangely enough, these groups consisted of four annuli. The leech is readily seen to be tetraannulate from the distribution of the papillæ. The furrows or gaps which occurred on the ventral surface, dividing off groups of four annuli, seem, then, to mark off the somite-limits, inasmuch as the number of annuli composing the groups

was the same as that entering into the somitic constitution, and their presence seemed to denote a more intimate connection of the annuli composing each group, with each other than with the annuli of another group.

On this reasonable assumption it was found that the sensory annulus was denoted by the third annulus of the somite. It has been definitely proved that the sensory annulus occupies the same position among two of the other three tetrannulate forms—*Pontobdella* and *Ozobranchus branchiatus*—so that we can safely conclude that the somite-limits are thus definitely shown by the assistance given by the furrows mentioned above, and that the sensory annulus is the third ring of the adult somite.

Reasons will be advanced later to show that all the tetrannulate leeches are similarly constituted in this respect.

*Geobdella tristriata*.—In examining a single specimen of this newly proposed species, gaps somewhat similar to those observed in the case of *Philemon pungens* were noted, and these are evidently due to a buckling of the body as the resultant of the effect of the killing fluid. These I proved, in the case of *Philemon*, to mark off the somite-limits, so that I have reasonably concluded that the same holds in this case. *Geobdella* is a pentannulate genus. In the two Australian species there are well developed papillæ, but I was unable to detect any such structures in the killed specimen of *G. tristriata*. However, inasmuch as the eyes have the same disposition, and the number of annuli is the same in all species, I have legitimately made use of the disposition of the papillæ as denoted in the other species, in mapping out the position of the sensory annulus in *G. tristriata*. In the manner denoted above, the greater part of the body is divided up into groups consisting of five annuli; and, by taking into account the position of the papillæ in the other species and the position of any of the above-mentioned gaps, I found that the sensory annulus was denoted by the first annulus of the pentannulate somite.

It is interesting to note that in *Philemon* and *Geobdella*, which anatomically are closely allied, the somite-limits were denoted in the peculiar manner indicated above. The fact that this occurs

in both, would seem to lend additional weight to the argument that the gaps do signify the dividing lines of the somites.

It is interesting to note that two of our Australian genera, *Semilageneta* and *Geobdella*, which are thus unique among the *Hirudinea*, as far as we know at present, in that the somite-extension has affected only the posterior region of the somite, thus leaving the sensory ring at the anterior extremity of the somite, have also other unique characters which are of some note. As mentioned previously, *Semilageneta* resembles in many respects the *Glossiphoniidae*, and again the *Ichthyobdellidae*. It is a Rhynchobdellid leech, but does not find its place definitely in either of the two divisions of that group. Again, *Geobdella* is unique in that it possesses only two jaws and has the genital apertures separated by seven and a half rings although the somite is pentannulate. This latter peculiar character of *Geobdella* may be due in some measure to the unique manner in which the annuli have been generated in connection with somite-extension.

Another noteworthy feature about *Semilageneta* is that there has been an absorption of somites at the anterior extremity, analogous to the fusion of the anterior somites to form the capula of the *Ichthyobdellidae*; and further, inasmuch as this absorption, judging from the position of the genital apertures, could only have affected a few somites, there must have been a great absorption of somites at the posterior extremity, since the number of somites represented externally is so very small in comparison with other leeches.

*Semilageneta* like *Ozobranchius* may yet have to be regarded as a type of a new family intermediate between the *Ichthyobdellidae* and the *Glossiphoniidae*.

*Conclusions.*—We must regard the *Hirudinea* as having been descended from an Oligochaetan-like worm which was uniannulate, and whose body consisted of 34 distinct somites. This represented the condition of the primitive ancestor of the group, as it left the main stem of the phylogenetic tree of the Annulata. Special

structures, such as the anterior and posterior suckers were developed, and in the generation of these were concerned the segments at the anterior and posterior extremities. In this connection took place the fusion of the ganglia of the originally distinct segments at these extremities. The traces of annulation sometimes visible on the posterior suckers of members of the *Hirudinea* in general, and sometimes on the capula of the *Ichthyobdellidae*, support this view. Later came the necessity for the extension of the somite in order to enable of an extension of the body, and this represents the direct reason behind the annulation of the leech-body, inasmuch as, apparently, the somite was incapable of giving rise to another distinct somite, or in other words there has been no increase in the number of ganglia, although the nervous system has given rise to special branches for the innervation of the newly acquired annuli which are so supplied quite separately from the original primitive sensory annulus, which represented, in fact, a sensory unit. This extension of the somite has been concerned chiefly in connection with the greater part of the body which may be termed more or less "central." We find the intermediate stages in the passage from the uniannulate to the multiannulate stage represented in proper serial order, passing from either extremity to that portion of the body in which the complete annulation characteristic of the genus is found. In these intermediate somites we find the key to the order of development of the annuli, and this order, although very different in each of many genera, is constant in the species of any one genus. It may not be out of place to remark here, that we find in such forms as *Branchiobdella* and *Bdellodrilus* a representative very closely allied to the hypothetical primitive ancestor of the *Hirudinea* at the time of its leaving the main stem, or very soon after. These organisms, although certainly not members of the *Hirudinea*, may represent in themselves, and probably do, examples of homoplasy, in that they have developed suckers; still they serve at the same time as examples of what has been said above.



Passing on from the uniannulate condition, we meet with *Microbdella* which is biannulate in the adult state of the somite. In this case the second annulus has been added posterior to the sensory annulus. By the addition of another annulus anterior to these, we meet with the normally developed triannulate adult somite which is so prevalent among the members of the *Rhynchobdellidae*.

*Mesobdella*, a distinctly Arhynchobdellid leech, represents the only member of that group, in which the somite retains its simple triannulate nature.

In some cases, however, we find that the third annulus developed is posterior to the second; in other words, that the sensory annulus represents the first annulus of the somite; examples of this are found in only a few genera such as *Semilageneta* and *Geobdella*. Such might well be expected as a variation even in the development of the "fundamental" triannulate somite, inasmuch as we find considerable variation in the order of development of the extra annuli in the evolution of the multiannulate somite. As far as I know, there is not one known instance among the *Hirudinea* in which the second annulus of a somite is developed anterior to the sensory annulus. After this annulus has been developed, it would seem then that two lines allowing for variation are opened up. In the majority of cases we find the third annulus developed anteriorly, but in some posterior to the second annulus. In the latter case, such as in *Semilageneta* and *Geobdella*, we find the sensory annulus represented by the first ring of the triannulate somite. The stimulus given to the exclusive division of the posterior annulus of the somite results in the formation, in *Geobdella*, of a pentannulate somite, the most anterior annulus of which is the sensory ring, and is to be regarded as representing potentially the primitive annulus of the somite.

In the following table is given a list, as complete as possible, of the more important of the known genera of the *Hirudinea*, and indicating the annulation of the various genera of the *Ichthyobdellidae*, *Glossiphoniidae*, *Herpobdellidae*, and *Gnathobdellidae*.

## Order RHYNCHODELLIDÆ.

Suborder ICHTHYODELLIDÆ.		Suborder GLOSSIPHONIDÆ.	
Genus.	Annuli in Somite.	Genus.	Annuli in Somite.
<i>Branchellion</i> .....	3	<i>Glossiphonia</i> .....	3
<i>Ozobranchus</i> .....	3	<i>Helobdella</i> .....	3
	rarely 4	<i>Hementeria</i> .....	3 dorsal.
<i>Pontobdella</i> .....	3 or 4		5 ventral.
<i>Oystobranchus</i> .....	7	<i>Placobdella</i> .....	3
<i>Trachylobdella</i> .....	3, 6	<i>Hemiclepsis</i> .....	3
<i>Callobdella</i> .....	6	<i>Microbdella</i> .....	2
<i>Piscicola</i> .....	12, 14		
<i>Semislageneta</i> .....	3		

## Order ARHYNCHODELLIDÆ.

Suborder HERPODELLIDÆ.		Suborder GNATHODELLIDÆ.	
Genus.	Annuli in Somite.	Genus.	Annuli in Somite.
<i>Herpobdella</i> .....	5	<i>Hirudo</i> .....	5
<i>Dina</i> .....	5	<i>Limnobdella</i> .....	5
<i>Trocheta</i> .....	6, 7, 8, 11	<i>Hirudobdella</i> .....	5
<i>Dineta</i> .....	5	<i>Macrobdella</i> .....	5
<i>Orobdella</i> .....	4, 6, 8	<i>Philæmon</i> .....	4
		<i>Geobdella</i> .....	5
		<i>Hemadipsa</i> .....	5
		<i>Mesobdella</i> .....	3
		<i>Xerobdella</i> .....	5
		<i>Cylicobdella</i> .....	
		<i>Lumbricobdella</i> .....	
		<i>Limnatis</i> .....	5
		<i>Haemopsis</i> .....	5

In only four genera of the *Hirudinea* is the complete somite known to consist of four annuli. In this category fall species of *Pontobdella*, *Ozobranchus Margoi*, *Orobdella Whitmani*, and *Philæmon pungens*. In all these forms it appears that the sensory annulus is represented by the third ring. This fact is of some special interest in the study of the order of development of the annuli from the unianulate to the multiannulate condition of the somite, especially as it bears directly on the question of

generic differences as regards the nature of the somite of the various leeches. It would seem that the order of the appearance of the annuli in these tetrannulate genera is different from that in such a pentannulate form as *Hirudo*, and furthermore that this is very possibly the reason that these forms are tetrannulate, etc., and not pentannulate. For example, in somite vii., of *Limnoddella australis*, or in fact of any species which falls within the limits of the characters given for the old genus *Hirudo*, we find four annuli. It is the second and not the third annulus in the latter which represents the sensory ring. I have already shown that somite iv. is biannulate, and somites v. and vi. triannulate in *L. australis*, and that in the former somite the anterior ring is sensory and both its component annuli partly fused. Again in somite v., the middle annulus is sensory and the anterior ring is partly fused with this, but the posterior annulus is distinctly differentiated. This shows clearly that the posterior annulus is the first non-sensory annulus to appear, and that the order of appearance of the various annuli of the somite is as follows:—

Annuli ... ..	1	2	3	4	5
Order of development ...	e	c	a	b	d

As has been clearly shown in the case of species of *Pontobdella*, and *Ozobranchus branchiatus*, the fourth annulus of the somite is represented by the anterior annulus of the tetrannulate somite. The order of appearance of the various annuli would then be as follows:

Annuli ... ..	1	2	3	4
Order of development ...	d	c	a	b

Inasmuch as this holds in the case of all the *Hirudinea* in which the adult somite is tetrannulate, and the former order in the case of most pentannulate forms, it seems reasonable to conclude that the effect of this variation is reflected in the nature of the adult somite. In connection with this question I might mention that in *Hæmenteria* we find the somites triannulate dorsally but pentannulate ventrally. This condition evidently obtains in all

specimens which may be deemed as mature, irrespective of details as regards age. From this we conclude that, in *Haementeria*, the somite has not yet reached the pentannulate condition, and further that this state would be reached by a division, evidently simultaneous, of each of the terminal or non-sensory annuli of the triannulate somite. The order of development of the annuli would then be:—

1	2	3	4	5
d	c	a	b	d

This order shows then again a variation from that which obtains in such pentannulate forms as *Hirudo*, and is intermediate between that which obtains in the latter forms and such forms as *Ozobranchus*, *Pontobdella*, *Orobodella*, and *Philæmon*. A point of further interest in connection with this is that the triannulate adult somite is the prevalent condition among the *Rhynchobdellidæ*, and the pentannulate among the *Arhynchobdellidæ*.

*Haementeria* is the only member of the *Rhynchobdellidæ* which shows any trace of the pentannulate somite, and occupying an equally unique position among the *Arhynchobdellidæ* we find *Mesobdella* which is the only member of the latter group in which the adult somite is triannulate. Both these genera then serve as intermediate forms between the *Rhynchobdellidæ* and *Arhynchobdellidæ* in connection with the nature of the somite.

*Summary.*—From facts and statements given above, it may be concluded in general that the posterior region of the sensory somite is first affected in connection with somite-extension. Further divisions may affect the posterior region exclusively as in *Semilageneta* and *Geobdella*, but in the majority of cases we find the anterior similarly affected. The fact that the division is proved to be restricted to the posterior region in some forms is not astounding, (and is very interesting in keeping with the fact that the posterior annulus of the biannulate somite is the first non-sensory annulus developed in that it shows a distinct stimulus behind this region) in regard to division, and inasmuch as considerable variation takes place in the evolution of the multianulate condition of the somite is but to be expected. In the

majority of forms, however, as stated above, the anterior portion of the somite is affected after the addition of the first posterior annulus. Later divisions typically affect both extremities, or in some cases may be restricted, at least for a time, to the anterior extremity. Examples of the latter are to be found in those leeches in which the adult somite is tetrannulate. After the formation of terminal non-sensory annuli the sensory annulus is, as a rule, not affected, but sometimes is as a result of the inability of the terminal annuli to undergo further division.

In discussing the question of metamerism I have attempted to explain the nature of annulation in all the forms as the result of an action of extension. There is no scientific support behind the flat denial that "abbreviation" or fusion takes place. However, if such a process does occur, it is quite secondary in importance and by no means frequent in occurrence.

#### EXPLANATION OF PLATE III.

Figs. 1A, 1B, 1C,—Diagrams showing the arrangement of the annuli in the genital somite of *Oroblella Whitmani*, *O. Ijimai* and *O. octonaria* respectively, according to the scheme laid down in the text.

Figs. 2A, 2B, 2C,—Diagrams of the same, showing the annuli of the genital segments arranged according to Whitman's scheme.

Figs. 3A, 3B, 3C,—Diagrams showing the arrangement of the annuli in *Geobdella*, *Phlemon*, and *Pontobdella macrothela* respectively.

# CONTRIBUTION TO A KNOWLEDGE OF AUSTRALIAN *HIRUDINEA*. PART VI.

THE DISTRIBUTION OF THE *HIRUDINEA*, WITH SPECIAL REFERENCE TO AUSTRALIAN FORMS, AND REMARKS ON THEIR AFFINITIES, TOGETHER WITH REFLECTIONS ON ZOOGEOGRAPHY.

BY E. J. GODDARD, B.A., B.SC., LINNEAN MACLEAY FELLOW OF THE SOCIETY IN ZOOLOGY.

Of the Australian forms enumerated in a list of species which I have made, at least five genera are characteristic of Australasia (in its ordinary geographical sense). Of these, three are aquatic genera—*Semilageneta*, *Dineta*, and *Hirudobdella*; the remaining two genera, *Geobdella* and *Philemon*, are land-forms. From this it will be seen that we have characteristic generic representatives of the *Ichthyobdellidae* (if *Semilageneta* must be allotted a position under the present classification), *Herpobdellidae* and *Gnathobdellidae*. Some little interest attaches to *Ozobranchus branchiatus* from a distributional standpoint, in that the only other known species of the genus is that noted by Apathy in the Mediterranean Sea. In connection with this, I have previously stated that this genus is evidently always associated, under parasitical conditions, with members of the *Chelonia*, in contradistinction to the confinement of species of *Branchellion* to the *Pisces*. *Chelone mydas*, the host of *Ozobranchus branchiatus*, is distributed over the Pacific, Indian, and Atlantic Oceans, so that, in all possibility, this member of the *Hirudinea* has a very wide distribution. Oka, in 1895, described a species from Japan which he doubtfully referred to *O. Mondesi*, and this, no doubt, is meant for *O. branchiatus*. Unfortunately I have not had the opportunity of reading Oka's original paper, and have gleaned my information from a reference made by Moore.

*Branchellion*, which is represented by at least three definite species in Australian waters, is a universally distributed genus, being noted from the Atlantic, Pacific, and Indian Oceans. *Pontobdella* is likewise a cosmopolitan form, and is represented by at least one definite characteristic Australian species, *Pontobdella australiensis*. *P. macrothela* was originally found by Schmarda in Jamaica, and Blanchard has noted the same species from Sumatra; so that the presence of this species in Australian waters would seem to indicate that it is universally distributed. *Semilageneta*, represented, up to the present time, by a single species known from no other part of the world, is interesting in that it is apparently intermediate between the Ichthyobdellid and Glossiphonid forms, as noted previously. No characteristic representative genus of the *Glossiphoniidae* is to be noted in Australasia. Three genera, *Glossiphonia*, *Placobdella*, and *Microbdella* have been found, the former in Australia and Tasmania, the latter two in New Zealand. The occurrence of *Microbdella* in the latter place is interesting, in that it was discovered almost exactly at the same time as Moore discovered and described the type-species, *M. biannulata*, from Carolina, U.S.A. As I have previously pointed out, no terrestrial member of the *Rhynchobdellidae* has ever been noted in any part of the world, and, in view of this, the occurrence of these freshwater forms in Australasia, in contradistinction to the limited distribution of the terrestrial members of the Hirudinea, serves as excellent corroborative evidence of the cosmopolitan distribution of freshwater forms of life, which is due, no doubt, to a great extent to the means of transmigration offered by birds, etc.

Among the *Herpobdellidae*, we find in Australia the cosmopolitan genus *Herpobdella*, and a genus, *Dineta*, confined, so far as is known, to Australia. The latter form, however, as has been noted previously, is very closely allied to the former, and, again, both these genera are freshwater forms.

The Gnathobdellid representatives fall into two groups, viz., aquatic and terrestrial. Among the former are comprised representatives of three genera—*Limnobdella*, *Hirudobdella*, and

*Hirudo*. *Limnobdella australis* of Australia and *L. mauiana* of New Zealand are exceedingly closely allied, and apparently they differ only in colour-pattern, and perhaps slightly in dimensions. Their anatomy agrees in the points of difference as cited for the differentiation of the genus from the common genus *Hirudo*. Whether we regard them as distinct species or not, their distribution is of some interest. In support of this, we find in New South Wales a new genus, *Hirudobdella*, which was originally discovered by Prof. Benham in New Zealand, in the form *Hirudo antipodum*, which Prof. Benham himself thought must fall into a new genus. *Limnobdella* is known from other parts of the world, and so, like other freshwater forms, has a cosmopolitan distribution. *Hirudobdella*, represented up to the present by one New Zealand species and one Australian species, is also a freshwater form; and, probably, when viewed critically from the standpoint of distribution, is to be regarded as a highly modified subgeneric offshoot from the *Hirudo*-stock.

In considering the question of distribution, perhaps the most important members of the Australasian Hirudinea are the terrestrial genera, *Philæmon* and *Geobdella*. Before entering into a discussion of the affinity and distribution of these forms, it will perhaps not be out of place to point out the distribution of the terrestrial *Arhynchobdellidae* throughout the world, with a view to pointing out the significance of their distribution in bearing on zoogeographical questions.

The number of terrestrial species is very small: so far only eight genera are known, five of which belong to the *Gnathobdellidae* and three to the *Herpobdellidae*. The former include:—

*Hæmadipsa* Tennent, 1861; Ceylon, India, Burmah, and Japan.

*Xerobdella* von Frauenfeld, 1868; mountains of Europe.

*Mesobdella* Blanchard, 1893; Chili.

*Geobdella* Whitman, 1886; Australia and New Guinea.

*Philæmon* Blanchard; Australia and Tasmania.



The *Herpobdellidae* include:—

*Cylicobdella* Grube, 1871; South America and West Indies.

*Lumbricobdella* Kennel, 1886; South America and West Indies.

*Orobdella* Oka, 1895; mountains of Japan.

Forbes, in 1890, also recorded the occurrence of a terrestrial species, in North America, of the genus *Semiscolex*, whose members are generally aquatic.

In comparing now the distribution of these forms with that of aquatic forms, it will be seen that the former are much more limited and do not enjoy a cosmopolitan distribution.

The *Hirudinea* in general were probably derived from an aquatic ancestor; and, in view of the fact that the great majority of species are still aquatic in habit, we must regard the terrestrial forms as being specially modified for a terrestrial existence, or as having specially adapted themselves to an environment quite different from that under which the majority of the forms have maintained their existence.

It might be merely suggested that the adaptation of some forms to a terrestrial existence might be due to the adaptation of an aquatic host by evolution to terrestrial conditions. This suggestion would receive some weight from the argument, which is well supported, that the *Hirudinea* represent an archaic group. At the same time it is to be borne in mind that several of the terrestrial *Gnathobdellidae* differ in only a small degree from certain allied aquatic forms of the same group.

In New Zealand, no land-leeches have yet been noted. Mr. Moore, of the United States National Museum, and Prof. Benham have shown definitely that the specimens of *Geobdella limbata* ascribed to New Zealand are identical with *H. (Uthionobdella) limbata* described by Grube from Sydney, and no doubt this represents the locality whence they were obtained. Further, land-leeches would certainly have been discovered long ago if they existed in the New Zealand bush. Two terrestrial genera have been noted in Australia, viz., *Philæmon* and *Geobdella*. Both these forms are very characteristic, and exhibit points of special interest. *Philæmon pungens* is the sole species known of

that genus, and is to be found in Victoria and Tasmania, and in New South Wales. *Geobdella* is represented by three species—*G. australiensis*, *G. Whitmani*, and *G. tristriata*—the former two being present in New South Wales and Queensland, and the latter in New Guinea. This latter distribution is of interest from a zoogeographical standpoint. The fact that they are so confined in their distribution would seem to indicate with some certainty that the problem of migration of the species of these terrestrial forms is much more difficult than in the case of the aquatic forms, and that we may consider them, in their distribution, seriously in connection with zoogeographical schemes. Again, these forms are in all probability limited to the eastern side of the continent, the conditions of moisture, and the sub-tropical nature of a good part of this area being much more suitable for such forms of life. We may probably conclude from this that the genus *Geobdella* had a range extending from Australia through at least part of the once existing Austro-Malayan Peninsula, and that in all possibility sufficient time has elapsed since the separation of this land-mass from Australia to allow of the evolution of the New Guinea species, *G. tristriata*, which is quite distinct from the Australian forms, and like them is terrestrial. Further, we are also to regard *Philæmon* as being characteristic of the southern half of the old Australasian continent, including Tasmania, and *Geobdella* of the northern and more tropical half.

Perhaps I may be excused, preliminarily, before entering on a discussion of the affinities of these two genera, if I attempt to review in consideration the distribution of these forms with a view to demonstrating their antiquity. If we assume that the occurrence of one and the same species of *Philæmon* in Tasmania, Victoria, and New South Wales, is not due to the interference of mankind (and this assumption I strongly support later), then we must conclude that this genus once spread over the whole of these combined areas when a land-connection existed between Victoria and Tasmania, and further that inasmuch as only one species is known, the genus must be a distinctly archaic one. In support of this, we have the interesting fact that *Geobdella*,

which, as will be pointed out later, is very closely allied to *Philemon* and might very well, on many scores, be regarded as a subgenus, is confined to the northern half of New South Wales, Queensland and New Guinea. In considering, then, the distribution of these two genera, we are forced to conclude that both have been evolved from a common stock, and that *Geobdella* has adapted itself to tropical and subtropical conditions, and *Philemon* to more temperate conditions.

I think that I may now reasonably suggest, if not conclude, that both forms are distinctly archaic. In concluding these remarks in their special reference to the question of distribution, it may be stated that one might reasonably have expected to meet with representative species of one of our Australian terrestrial genera in some of the Island groups to the east of Northern Australia which, many men of science, in consideration of the continental nature of the group, have suggested were connected as an extension in an easterly or south-easterly direction with the Austro-Malaysian Peninsula. When engaged in a collecting tour in Fiji some years ago, although I spent some months in active collecting in the thick bush of that region, I met with no member of the group, nor did I ever hear any reference made by natives, a vast number of whom rendered me every assistance possible in my work, and most enthusiastically proffered any information they had. Further, I know of no records from the New Hebrides. This leads one, at the least, to suggest that neither of the Australian forms found its way beyond New Guinea, either in an easterly direction or in a westerly direction. I have mentioned these details with a view to suggesting that our two Australian genera have arisen from a common Australian ancestor which was evidently not far removed from either of them in nature; and further, that this evolution has taken place since the splitting up and separation of the outer portion of the supposed peninsular continental mass but prior to the separation of New Guinea from Australia. Again, if New Zealand were ever connected in a northerly or north-easterly direction with any of the continental masses above mentioned, the absence of these forms in New Zealand is explained

either by the fact that they never did spread to any distance in an easterly direction, or that this hypothetical connection with New Zealand is of enormous antiquity.

In discussing the relationship of the two genera, *Philemon* and *Geobdella*, it is interesting to see that they show marked affinities, which in themselves are unique characteristics of the two genera, viz., the presence of only two jaws, and the same position of the eyes. These affinities must be seriously considered as representing certain fundamental characters common to both, and probably to be found in an ancestor common to both, inasmuch as one of these points, viz., that of the jaws, is a most important factor to be considered in connection with classification. At the same time there are wide differences between them which would seem to indicate that both forms have long been differentiated sufficiently for the generation of separate genera. I have pointed out, in connection with the subject of metamerism, in another chapter that in *Geobdella* the pentannulate somite has been derived from the uniannulate segment by the addition of four annuli posterior to the primitive ring, whereas in *Philemon* the sensory ring is denoted by the third annulus of the tetraannulate somite, indicating that the order of origin of the annuli is quite different. The question is now to be considered whether this tetraannulate condition has been arrived at by the absorption of the last annulus of the pentannulate somite, as seen in *Geobdella* (or the pentannulate somite by the addition of another annulus to the tetraannulate somite of *Philemon*); or whether these two forms were differentiated after the common ancestor had developed the biannulate somite. One finds that, in connection with somite-constitution, the chief change is that of extension, or in other words, the generation of the multiannulate condition. This we know definitely has taken place extensively in all members of the *Hirudinea* to a greater or less extent, but, at the same time, there is no substantial scientific support behind the denial that retrogressive changes ever take place, that is, that an abbreviation may take place secondarily. If one removes the last annulus of the pentannulate somite of *Geobdella*, it will be seen that the sensory annulus would not occupy the same position as

that seen in *Philemon*, with its tetrannulate somite; or again, by adding another annulus to the somite of *Philemon* the pentannulate somite of *Geobdella* would be obtained; but the position of the sensory annulus would not correspond in both.

It must, of course, be borne in mind that although the number of annuli in the whole body is different in the two genera—79 in *Philemon*, 95 in *Geobdella*—and the peculiar positions of the genital apertures in *Geobdella* are of great importance, their anatomy agrees very closely.

The total number of annuli in the body is dependent on the fact that one is pentannulate, and the other tetrannulate, and this may explain to some extent also the peculiar relative positions of the genital apertures in *Geobdella*, which at first would seem to be of such great importance.

In view of what I have stated in connection with metamerism and the importance of the order of origin of the annuli in discussing genetic relationships of leech-forms; and taking into consideration what I have stated as conclusions to be drawn from a study of the distribution of these two forms as a reflection of their archaic nature; seeing that the order of origin of the annuli is so different in these two forms; I conclude that they have been derived from a common ancestor which agreed very closely with them in regard to the jaws, position of the eyes, and general anatomy, but which, at the time these two genera were differentiated, had not developed a somite of more than two annuli.

In conclusion, I may state that the remarks which have been made in this paper in regard to the conclusions to be drawn from the distribution of our terrestrial *Hirudinea* in regard to zoogeographical schemes, are in keeping with those which the distribution of Monotremes, Marsupials, and Peripatus, etc., has long since justified. In this direction I have, then, merely added corroborative evidence from a study of the *Hirudinea* themselves, and have hopes that I have conclusively pointed out that the terrestrial members in general of the *Hirudinea* serve as good types to be considered in connection with a study in zoogeography.

REVISION OF *SYMPETES* AND *HELÆUS*: WITH  
 DESCRIPTIONS OF NEW SPECIES OF *TENEBRIO-*  
*ONIDÆ* [COLEOPTERA].

BY H. J. CARTER, B.A., F.E.S.

Revision of the genus *Sympetes* (Pasc., Journ. of Ent. ii., p.464).

**History.**—In 1866 Pascoe formed this genus for the reception of *S. Macleayi*. It is distinguished from *Helæus* by the anterior angles of the thorax not meeting in front of the head, and from *Saragus* by the mesosternum having no notch for the reception of the prosternal process. Pascoe does not appear to have examined the types of Hope and de Brême, or he would have included *S. contractus*, *S. testudineus*, and *S. Brêmei* of the former; and *S. gagates*, *S. orbicularis*, *S. rotundatus* and *S. subrugosus* of the latter author. This is the more curious, since he refers to *S. (Encara) tricostellus* White, as belonging to this genus, of which the type is in the British Museum. Moreover he described *Saragus patelliformis* (Ann. Mag. Nat. Hist. 1870, p.100), leaving it to Mr. Champion to point out that this species as well as *S. Duboulaii* Pasc., is a *Sympetes* (Trans. Ent. Soc. 1894, p.384). From de Brême's figure there is little doubt that *S. unicarinatus* Boisd., should also be included in this genus, though I do not know this species. In 1896, Lea described two species, *S. acutifrons* and *S. undulatus*.

Thus Masters' Catalogue contains only two names under *Sympetes*, viz., *S. Macleayi* Pasc., and *S. magister* Pasc., while Lea has added two under the genus. Of these four, two are, I consider, synonyms, while *S. magister* Pasc., is certainly not a *Sympetes* at all.

Ten species have been removed from other genera into this group, and three new species are herein described, making a total

of fourteen known species; all (except *S. unicarinatus* Boisd., from Kangaroo Island) being denizens of West Australia.

### Synonymy.

(1) *S. tricastellus* Brême(nec White) = *S. contractus* Hope, = *S. gagates* Brême.

(2) *S. Macleayi* Pasc. = *S. tricastellus* White.

(3) *S. Duboulaii* Pasc. = *S. Brêmei* Hope.

(4) *S. undulatus* Lea = *S. testudineus* Hope.

(5) *S. magister* Pasc. = *Pterohelæus Icarus* Carter, and is not a *Sympetes* (vide *infra*).

*S. tricastellus* Brême(nec White) = *S. gagates* Brême = *S. contractus* Hope.—Through the courtesy of Mr. H. Giles, of the Zoological Gardens, Perth, I have obtained a long series of *Sympetes* from that district. My own notes taken at the Hope Museum, and at the London Nat. Hist. Museum, with further valuable help given most generously by Mr. C. J. Gahan, enable me to affirm the above synonymy with some certainty. At first I was inclined to separate my specimens into two species, distinguished as follows, the larger A(19-20 × 14-15 mm.) very nitid, with smaller punctures on the elytra: the smaller B(16-18 × 11.5-12 mm.) with larger elytral punctures. Extreme forms of these are in the Macleay Museum, Sydney, A, (from Rottnest Island) labelled *S. tricastellus* White; B, labelled *S. gagates* Br. A, moreover, is more convex, with the lateral margins proportionately narrower, especially at apex. All the specimens of A are ♀, while those of B are ♂. A agrees very well with Brême's figure of *S. tricastellus*, B with that of *S. gagates*. Mr. Gahan writes, "The specimen you take to be *S. tricastellus*(Brême) agrees rather better than the smaller one with what we have as *S. contractus* Hope. I don't think your two specimens are really specifically distinct. Our set of specimens here are all more or less intermediate between the two, both as to size and punctuation of the elytra." The variations in form, especially sexual, are, therefore, probably responsible for this synonymy. *S. contractus* Hope, is evidently, by figure and description, one of these. Indeed,

Hope's note "it may be considered at a future period as forming a subgenus" seems to show that he did not know the two species described by de Brême, notwithstanding his reference to de Brême's monograph, and the statement that "several of the species were described from my coll." since the figures given by Brême would show the strong likeness. Moreover, there is an evident error in the dimensions given by Hope as "Long. lin.  $9\frac{1}{2}$ , lat. lin.  $3\frac{1}{2}$ ," while the figure (Trans. Ent. Soc. 1848) shows an insect  $9\frac{1}{2} \times 6$  lines (by taking the length as the standard). The above specimens A and B are therefore ♀ and ♂ of the species which must be known as *S. gagates* Brême.

*S. Macleayi* Pasc. = *S. tricoellus* White.—Mr. Gahan has had the Hope type sent from Oxford to compare with the Pascoe and White types in the British Museum. It is evident, both from Mr. Gahan's information and from White's description (Grey's Travels, App. p. 464) that de Brême was mistaken in his identification of *S. tricoellus* White. The first words of White's description are "Much larger than *E. gibbosus*, of a dirty brown, glossed, the wide margin of elytra flat." Here are three statements which apply to *S. Macleayi* Pasc., but not to *S. tricoellus* Brême. Mr. Gahan writes, "*S. contractus* Hope, is not the same as *S. tricoellus* White. It is much smaller, darker or more strongly chitinated; differs a good deal in shape of pronotum" (a rough sketch of each is sent). "The species figured by Brême as *S. tricoellus* White, looks very much more like *S. contractus* Hope, and Brême's *S. rotundatus* has, in the figure, a form very like that of *S. tricoellus* White, but is much smaller. *S. Macleayi*, Pasc., comes nearer to *S. tricoellus* White, than does *S. contractus*, but is somewhat more oblong and less rounded in form" [*S. Macleayi* Pasc., is often much rounded. H.J.C.]. "I think it possible that *S. rotundatus* is only a small *S. tricoellus*. Our biggest *S. tricoellus* is  $24 \times 20$  mm. I feel confident, however, that *S. contractus* Hope, is distinct from *S. tricoellus* White, but it appears to be *S. gagates* Brême, and *S. tricoellus* Brême (nec White)." From this it is evident (1) That *S. tricoellus* White, was not correctly identified by de Brême. (2) *S. Macleayi*



Pasc. = *S. tricoellus* White. The variability, especially sexual, in the form of the latter would easily cover Mr. Gahan's remarks on that point, while my measurements of specimens identified as *S. Macleayi* Pasc., are quite in accord with those of *S. tricoellus* White, in the British Museum. The remark as to *S. rotundatus* being possibly only a small *S. tricoellus* is especially strong evidence, since I have had some difficulty in separating *S. rotundatus* from *S. Macleayi* except by size. *S. tricoellus* White, was described from King George's Sound, not from Swan River as de Brême states of his species. Macleay has pointed out Pascoe's omission of the carinated prothorax in his species. There is considerable variation also in form, size, and convexity. Six specimens under observation vary from  $23 \times 18.5$  to  $27 \times 21$  mm. As in the other species of this group of *Sympetes* (B of table, *infra*), the male is smaller than the female, with the discal portion more convex, subapical margins narrower than on basal half. The apical spines on tibiae are shorter in the male. My specimens are from Albany and Kellerberrin.

*S. Brêmei* Hope = *S. Duboulaii* Pasc.—This synonymy has already been suggested by Lea and by myself. Mr. Gahan has corroborated this by a comparison of the types, and writes—"The type of the latter is a small black specimen, but shows no structural difference." My own specimens vary in colour from light brown to black, and this may be explained by immaturity. I am inclined to think that this species, like other sand-dwellers (e.g., *Scymena variabilis* Pasc.) may be of either colour when mature.

*S. undulatus* Lea = *S. testudineus* Hope.—Having seen the types of both at different times, I have only my memory to add to the evidence of their descriptions. Mr. Lea's note (These Proc. 1897, p.586) as to the absence of the anterior tibial spur is scarcely sufficient to constitute a distinction. The geographical difference may be noted. *S. undulatus* is from Geraldton, *S. testudineus* is from Port Essington. Mr. Gahan writes—"S. undulatus Lea, is, I think, *S. testudineus* Hope, after comparing his description with the type of the latter." My own measurements

of the Hope Museum specimen do not agree with those given by Hope. Mine give  $20 \times 15$  mm., while Hope's description (incorrectly quoted by Macleay as  $8\frac{1}{2} \times 7\frac{1}{2}$  lines) gives  $8\frac{1}{2} \times 6\frac{1}{2}$  lines.

*S. magister* Pasc. = *Pterohelaeus Icarus* Carter = *Saragus magister* Pasc.—Suspecting this species to be out of place amongst *Sympetes*, and my evidence suggesting the above synonymy, I sent a specimen of my *P. Icarus* to Mr. Gahan, who writes—“*S. magister* Pasc., is, as you correctly surmise, a true *Saragus*, with mesosternum hollowed out for reception of the prosternum. The specimen you send appears to be the same species, allowing for a certain amount of variation. It is a little larger than either of Pascoe's two specimens, with the prothorax a little more expanded at the sides, and the margins more convex. Your specimen also shows some rows of very small punctures on the front half of the disc of the elytra. . . . It is certainly conspecific with one of our two specimens. The other (the actual type described) differs in having no punctures on the elytra, except the row at the junction of the explanate border.” This must, I think, establish the above synonymy. Together with *P. Darwini* Lea, lately examined by me, through the courtesy of Mr. Lea, *S. magister* forms a valuable link in the chain connecting *Pterohelaeus* with *Saragus*. The short metasternum in both, with the merely rudimentary wings, clearly separate them from *Pterohelaeus*, while it is probable that a dissection of fresh specimens of many species of *Saragus* would show some approximation to these rudimentary wings. As it is inadvisable to create a new genus on so (to my mind) insufficient a character, both species must at present be referred to *Saragus*. I have not, however, been able to find these wings, so far, in *S. Pascoei* MacL., (the nearest in general facies to *S. magister* Pasc.). The wings in *S. magister* extend about half-way from base to apex, and less than half-way from sides to suture, being attached near the shoulders. The species has a wide distribution over the inland parts of South Queensland and New South Wales. My specimens are from Forbes and Toowoomba, and all have the fine punctuation noticed by Mr. Gahan, but omitted from my description (possibly obscured by grease at the time).

Notes.—*S. rotundatus* Brême. This species is very close to *S. Macleayi* Pasc., (*S. tricoellus* White), but is separated by evident and apparently constant differences of size. Specimens of both sexes from Perth measure 16-18 mm. long, while *S. tricoellus* White, varies from 23 to 27 mm. long, and is found near Albany. *S. rotundatus* is also more finely punctured, especially on the underside of the margins, which are, out of all proportion, very much more coarsely punctured in the larger species.

*S. subrugosus* Brême.—Identified from Perth, where it is apparently common, exactly corresponding to figure and description. This is possibly the insect referred to by Champion (Trans. Ent. Soc. Lond., 1894, p.384) as differing from *S. patelliformis* Pasc., "in having the prothorax more densely punctured and with sharper anterior angles." If I have identified *S. patelliformis* correctly, they are very different, the latter having a smoother surface, with the elytral costæ subobsolete, while in *S. subrugosus* they are quite evident.

*S. unicurinatus* Boisd., from Kangaroo Island.—I have seen the type in the Paris Museum, but have never seen any other specimen.

*S. orbicularis* Brême.—I have five specimens under observation, which seem to belong to this species. Three are from Kellerberrin, W.A., taken by Mr. Duboulay, junr.; the other two are labelled W.A., and are in the French Coll. of the Melbourne Museum. Here, as in the case of *Pterohelæus Guerinii* discussed by me (These Proceedings, 1909, p.123), there is a curious discrepancy between the dimensions in the description and the dimensions of the plate given in de Brême's Monograph. In the description, the dimensions are given as long. 19, larg. 16 mm., whereas the plate, if standardised by the length, gives  $19 \times 14$  mm.; there is the further mistake in the reference to the plates given in the description, fig.3 being (as correctly stated on the plate) *S. rotundatus*, fig.4, *S. orbicularis*. Following the plate, fig.4 as correct for the width, I have no hesitation in identifying *S. orbicularis* as the Kellerberrin insect. In only one specimen is the prolonged apex as distinct as in the plate.

The following are descriptions of three new species, together with a table to assist identification :—

*SYMPETES BICOLOR*, n.sp.

Widely ovate, shining, glabrous, discal portions of upper surface and borders of foliate margins piceous-black or brown; foliate margins above and below creamy-yellow; abdomen, under-side of disc, legs and antennæ reddish.

*Head*: labrum narrowed in front and evident, epistoma truncate and a little raised, front with a triangular ridge in front of eyes, the apex between the eyes depressed, transverse suture separating front from epistoma well marked, the whole evidently but sparsely punctured; antennæ not extending to base of prothorax, basal joints very slender and subcylindrical, apical four joints enlarged, 8-10 obconic, eleventh elongate-ovoid. *Prothorax*: very transverse and flat ( $5 \times 13.5$  mm.), the discal portion occupying about one-third of the total width, greatest width at base, apex circularly emarginate, anterior angles strongly produced in front of the eyes, acutely dentate and pointing upwards, sides rapidly expanding in a wide curve, sinuate anteriorly, posterior angles very acute, slightly upturned and overlapping elytra; extreme borders wide, convex, reflexed on upper and lower margins except near anterior angles, base and apex with narrow dark reflexed border, base trisinate, foliate margins nearly flat and dotted with very shallow punctures; disc almost flat and rather uneven, with irregular depressions, central carina sub-obsolete but faintly defined near base by a depression on each side, the whole finely punctulate. *Scutellum* semicircular and keeled. *Elytra* wider than prothorax at base, wider than long ( $15 \times 16.5$  mm.); foliate margins nearly equally wide all round, widest at base where they are two-thirds of total width, slightly narrower at apex, humeral angles widely obtuse, sides slightly widening to about half-way, each elytron separately rounded at apex, borders concave, of same width as those of prothorax when viewed from the side and similarly reflexed above and below, foliate margins very thin and transparent, slightly undulate, with

humeral callus prominent and a less prominent convexity half way, closely dotted with shallow punctures: disc with suture strongly carinate throughout, and five fairly definite smooth costæ on each elytron; of these the first is a short postscutellary costa parallel to the sides of the scutellum, the next three, parallel and equidistant, extend from the humeral region, obliquely approach the suture, becoming obsolete on apical declivity, the fifth subobsolete, half-way between the fourth and the outside of disc; junction of disc and margins marked by a line of large punctures in a depressed line, these most evident towards apex, the extreme border of disc itself a little raised and crenulate; the intervals between costæ faintly rugose, coarsely and irregularly punctured. Abdomen finely and closely, underside of foliate margins coarsely punctulate, tibiæ armed at apex with two spines, one very long, under surface of legs rugose, tarsi and lower parts of tibiæ clothed with yellow hairs. *Dimensions*— $19 \times 16.5$  mm.

*Hab.*—Shark Bay, West Australia; sent by Mr. C. French.

I have two specimens, both, I think, ♀, generously presented by Mr. French. While evidently very close to *S. acutifrons* Lea (from Geraldton), the dimensions, especially the proportion of length to width, differ sufficiently to make a clear distinction; moreover, in Lea's species the margins are testaceous, while in *S. bicolor* they are a distinct cream-yellow in both specimens; *S. acutifrons* Lea, is described as having elytral interstices "irregular, feebly raised," in *S. bicolor* the costæ are evident. Type in author's coll.

I have since compared it with Lea's type, and find it evidently distinct in (1) the much stronger contrast of colours in disc and margins; (2) the much wider form, especially of explanate margins; (3) wider head with more truncate epistoma.

#### SYMPETES QUADRATUS, n.sp.

Widely and squarely oval, dull brownish-black, tarsi and upper surface of antenæ red.

*Head* wide, a little convex, with epistoma squarely truncate and overlapping the labrum, front angles squarely rounded and a

little reflexed. Eyes large, transverse, bordered in front by oblique moderately raised impression; front very minutely granulose; antennae as in *S. Macleayi* Pasc. *Prothorax* very transverse, depressed ( $6 \times 16$  mm.), deeply and squarely emarginate, anterior angles almost (in one case quite) enclosing the head, anterior angles sharply rectangular, with extreme apex showing a tendency to form a tooth. Sides widely rounded, strongly reflexed, widest at the acute posterior angles. Base strongly bisinuate. Border wide in front (where it is notched in the middle) and sides, narrow at base. Viewed from the side, the edge is convex and continuous with the under surface, and narrower than that of the elytra. Margins very wide and covered with minute granules. Disc much smoother, almost obsolete carinate towards apex, but raised into a narrow hump towards base. Discal portion 6.5 mm. wide. *Scutellum* transversely elliptical at base, apparently smooth. *Elytra* wider than long ( $14 \times 17$  mm.), squarely oval, greatest width behind the middle, a little narrower than prothorax at the shoulders, these widely obtuse; sides gradually expanding till near apical third, then rather abruptly rounded. Apex triangularly notched at suture. Margins not so wide as those of the prothorax, widest at shoulder (where they are slightly gibbous) and behind the middle, narrower at middle and apex through the bulging of the discal parts in these regions; finely and rather distantly granulose. Disc moderately convex throughout, rugosely punctulate, with three faintly indicated costae about equidistant from one another, more or less parallel, becoming obsolete on apical declivity. Suture strongly carinate from base to the junction with margin, only slightly raised on apical margin. *Prosternum* minutely granulose, metasternum and abdomen finely rugosely punctured, the sculpture of abdomen appearing like a series of longitudinal scratches, reverse of margins coarsely punctate. The whole underside a dull black. Legs finely punctulate and with short scattered recumbent hairs of a reddish colour. Tibial spines shorter and thicker than in *S. Macleayi* Pasc. *Dimensions*—19.22 mm. long, 17.19.5 mm. wide.

*Hab.*—Shark Bay, West Australia.

Four specimens, all ♂, sent by Mr. W. Duboulay, junr. It is easily distinguished from its congeners by its extraordinary width and square shape. In this respect it is the widest beetle known to me. More convex than *S. Macleayi* Pasc., but less so than *S. gagates* Brême. Type in author's coll.

SYMPETES EXCISIFRONS, n.sp.

Almost circular, convex, coal-black above, antennæ and underside opaque piceous-black, discal surface vitid, underside and legs sparsely clothed with short adpressed reddish hairs

*Head*: labrum not evident, epistoma widely truncate, its angles rounded in ♂, obtuse in ♀; behind this angle a distinct curved excision, sides then narrowing to the eyes (not raised as in *S. orbicularis* Brême, nor is frontal ridge so prominent), surface minutely but not closely granulose, eyes more widely separated than in *S. orbicularis*, antennæ stouter. *Prothorax* nearly four times as wide as long (length measured in the middle), widest at base, widely explanate, disc about as wide as the two margins combined, deeply arcuately emarginate in front, anterior angles very slightly rounded and obtuse (about 100°), extending almost to the excision in epistoma, sides circularly widening and forming a continuous curve with sides of elytra, border more strongly recurved than in *S. orbicularis* Br., posterior angles acute and overlapping elytra. Disc with central carina less evident than in *S. orbicularis*, surface apparently smooth and impunctate, foliaceous margins minutely granulose and nearly horizontal. *Scutellum* transverse, triangular. *Elytra* wider than long, widest behind middle, less convex than *S. orbicularis*, more convex than *S. quadratus*, strongly carinated at the suture throughout, disc much more coarsely and deeply punctured, with interstices irregularly transversely rugose, and with two or three subobsolete ~~costæ on each elytron~~ showing near base, the most evident of these, near the suture, continuous from base to apex; surface subglabrous, sparsely clad with minute black bristles; margins flat, wider than in *S. orbicularis*, with extreme border thicker

and more recurved, minutely granulose and separated from disc by a line of large lateral punctures. Underside a darker colour, but similar to *S. orbicularis*. *Dimensions*—♂, 15.5 × 13.5; ♀, 18 × 16 mm.

*Hab.*—Onslow, West Australia; sent by Mr. C. French, F.L.S.

Two specimens are under examination, one of either sex. This species is intermediate in form between *S. orbicularis* Brême, and *S. quadratus*. From the former it is differentiated, *inter alia*, by its wider and more circular shape, coarser sculpture of elytra, and its wider margins. These last are much narrower than in *S. quadratus*, which moreover has sharply defined rectangular anterior angles to the prothorax, and is altogether a flatter and larger insect. The excised head, immediately behind the anterior angles of the epistoma, should serve to identify this species. It is so distinct in the female specimen that I thought it was an accidental breakage, until the male showed a similar but smaller excision. The elytral sculpture of the three species is thus to be differentiated:—

*S. excisifrons*—punctures regular, clearly separated, round and deep; intervals coarse, shining, irregularly rugose.

*S. orbicularis* Brême—punctures irregular, large and small, but on the whole smaller, closer and less deep than in *S. excisifrons*; intervals showing no definite ridges on central portion and only slightly at sides.

*S. quadratus*—densely packed with small round punctures, the intervals more finely but more distinctly rugose than in *S. excisifrons*.

#### Table of *Synipetes*.

A. Explanate margins of elytra oblique, not horizontal, surface strongly chitinated.

*S. gagates* Brême = *tricotellus* Brême (nec White) = *contractus* Hope.

B. Explanate margins flat and horizontal, surface less chitinated.

a. Explanate margins of elytra together as wide as disc at base.

b. Anterior angles of prothorax acutely produced.

c. Form very wide (margins of elytra 3.5 mm.).....*bicolor*, n.sp.

cc. Form narrower (margins of elytra 2 mm.).....*acutifrons* Lea.

bb. Anterior angles not acute.





Section i. has already been discussed by Blackburn, and his suggestion that the study of the external margin of the prothorax and elytra would give valuable results is fully endorsed by the present writer. I regret the want of opportunity of examining his types closely, as it is doubtful if he has always allowed enough for the natural variations of the variable species of this genus. Thus *H. aridus* Blackb., seems to me to be the same, or at most but a variety of *H. princeps* MacI. (Hope?). The distinction drawn by the author of the first, lies in the absence of the carina on the prothorax of *H. aridus*, which is present in *H. princeps*. In the Macleay Museum are two specimens labelled *H. princeps* Hope, by Macleay. In one of these this carina is distinct, in the other specimen it is almost obsolete. They are from the same district, and are evidently conspecific. There is a large collection of duplicates from the interior of South Australia, which show the same variation. This fact throws some doubt as to the value of *H. aridus* Blackb., as a distinct species, and can, I consider, only be admitted as a variety of the species passing for *H. princeps* Hope. Another character—that by which *H. lubricus* Blackb., is distinguished from the two preceding in the table—is “sutural carina of elytra (viewed from the side) being parallel with the edge of the lateral margin and straight in the middle (about half) part of its length.” This character, depending only on the convexity of the disc, might be and is often only a sexual difference, and without several examples should not be used to differentiate species.

*H. subseriatus* Blackb., and *H. elongatus* Blackb.—The author distinguishes between these by the elytral punctures of the former being extremely fine, and of the latter very distinct. I have had several specimens identified readily as *H. subseriatus* from Nungarra, W.A. (sent by Mr. Giles), and one specimen which I identify as *H. elongatus* from Kalgourlie. These species, though closely allied, are, I consider, quite distinct.

*H. Brownii* Kirby.—This species was omitted by Mr. Blackburn from his table. There is a specimen in the Macleay Museum which is, I believe, correctly identified. The lateral

edge of prothorax is concave, as wide as that of the elytra and faintly rugulose. The elytra have rows of small, distant pustules. There is an evident subsutural costa near scutellum, the others obsolete. The basal tooth on prothorax is sharp, erect, and sub-conical, while the carina in front is subobsolete. Dimensions,  $20 \times 11$  mm.

Section ii.—*Elytra pilose or tufted*.

There are five species so far described, on which I append short notes.

*H. perforatus* Latr., is the original type of the genus. I have taken specimens at Perth, and have examined the type in the Paris Museum. It is well known in all collections by its four rows of long black hairs.

*H. Kirbyi* Brême.—I have a specimen from N. W. Australia, easily to be distinguished from *H. perforatus* by the following characters—Form more regularly elongate-oval (less enlarged posteriorly), margins narrower and more horizontal, tufts of hair shorter, more sparse and red; prosternal keel more elevated and nitid, especially between the coxæ.

*H. Spencei* Brême, possibly a variety of the former, has its elytra much wider than the thorax.

*H. Spinolæ* Hope, differs from all others of the genus in that the anterior processes of prothorax do not meet in front. Macleay therefore placed it in the *incisus*-group of *Saragus*. Having seen the type in the Oxford Museum, I have no doubt as to its being a true *Heleus*, and am inclined to consider it as an aberrant form of *H. perforatus*. I have never seen any other specimens.

*H. fulvo-hirtus* Lea, is much smaller than the preceding. Lea gives  $20 \times 14$  mm. as the dimensions, but a specimen in the Macleay Museum, presented by Mr. Lea, measures  $19 \times 12$  mm. The prosternum is rounded, not carinate, the elytra finely punctured.

Section iii.—*Elytra biconstate*.

Synonymy.—*H. falcatus* Pasc., = *H. Perronii* Boisd. (?) As in most cases, Boisduval's species are impossible to identify by

description, the one useful fact therein being its locality, Kangaroo Island. De Brême redescribed it, giving a figure, as from Swan River. It seemed improbable to me that this distribution, and, therefore, identification was correct. I was unable to find Boisdual's type in the Paris or Brussels Museums, but Mr. Gahan has kindly sent me a specimen labelled *H. Perronii* Boisd., from the British Museum for examination, with the locality-label of Kangaroo Island (A. H. Davis). This specimen is identical with specimens in the Macleay Museum, and Mr. Lea's collection, as *H. falcatus* Pasc., and corresponds exactly with Pascoe's description. It is probable that Pascoe relied on de Brême's monograph, already shown to be fallible in the case of *Sympetes tricostellus* White. Until Boisdual's type is shown to be identical with de Brême's, it is preferable to assume that the two insects described from Kangaroo Island are the same. It is thus possible that one of the new species described below may be the insect figured and described by de Brême as *H. Perronii* Boisd.

*H. consularis* Pasc.—I have two specimens, exactly corresponding to the author's description, from Kellerberrin, W.A., taken by Mr. Duboulay, junr., and one from Norseman, W.A., which differs only in the prothoracic processes not meeting. I consider this last only a variety. In these Proceedings, 1889, p.1269, Mr. Blackburn has some doubt as to the distinction between this species and *H. moniliferus*. Macleay also notes that it was unknown to him. The following comparison of prominent characters will therefore be useful :—

*H. consularis* Pasc.

Form obovate, widest at shoulders.

Elytral costæ not parallel or approximate.

Pronotal carina reaching base.

Prosternal keel not raised at apex, smooth behind and rounded between coxæ.

*H. moniliferus* Pasc.

Form ovate, widening behind shoulders.

Costæ much closer, parallel for greater distance.

Pronotal carina not reaching base.

Prosternal keel sharp, even, produced behind.

I have examined many specimens of *H. moniliferus* in the Macleay Museum, which are cotypes of those sent to Pascoe by Mr. Masters from South Australia. I have received specimens from Mr. Goudie from Sea Lake, N. W. Victoria.

*H. ellipticus* Lea, is easily differentiated from the former two, by its elongate-ovate form, the sides being parallel behind the shoulders. The prosternal keel is strongly raised throughout, is notched, bifid, and wedge-shaped at apex, and strongly produced behind coxæ; the elytral costæ are crenated only on the outside (on both sides in the former two species), and there is a raised border round the eyes with a sulcus intervening between it and the eyes. Mr. Lea has kindly lent me his type for examination. My specimens are from Condon and Mt. Margaret, W. A.

*H. castor* Pasc.—This species, and its ally *H. Georgei* Cart., are much flatter than the rest, with the prosternal keel obsolete. The under side of the prothoracic flange of *H. castor* is thickly pitted with large punctures.

*H. squamosus* Pasc.—Specimens compared with cotypes in the Macleay Museum have the front angles rounded and overlapping, with the elytral costæ terminated on the apical declivity. The four apical joints of antennæ are distinctly broader than the rest. My specimens are from Cunnamulla, Q.; Mildura, Vic.; and Tarcoola, S. A.

*H. Derbyensis* MacL., compared with what, I presume, is the type, though unmarked as such in the Macleay Museum. The front angles are acute and scarcely overlapping, the pronotal carina smaller and more uniformly elevated. The last three joints of antennæ are not broader than the rest, while the elytral costæ are continued almost to the apex. The suture is slightly carinate at apex, though Macleay says it is not. My specimens are from Condon, N. W. Australia, taken by Mr. Giles.

In both the last two species the prosternum is nearly flat.

*H. Mastersi* Pasc.—There is a specimen labelled Salt R. (W. A.) in the Macleay Museum which, Mr. Masters assures me, is a cotype of the specimen sent to Pascoe. If this be so, Pascoe's description is in error in stating that it is "furnished above with

short erect black bristles" (Ann. Mag. Nat. Hist. Ser. 4, Vol. v., p. 99). This specimen, which is exactly similar to one sent by Mr. Duboulay, junr., to me from West Australia (unlabelled), is furnished above with distinct red bristles, but otherwise corresponds to the description. I am unwilling to doubt the evidence of so accurate an entomologist as the veteran Curator, and have written to the British Museum for information on this point. In reply, Mr. Gahan writes, "*H. Mastersi* Pasc., has distinct bristles of a rather darkish or rusty reddish colour, not black."

*H. sparsus* Cart., (*infra*) is particularly interesting as forming a link connecting Sections ii. and iii., having the long tufts of hair as in Section ii., with the bicostate elytra of Section iii. There are two specimens in the Melbourne Museum, identified by myself.

Section iii. *Elytra bicostate* (suture sometimes costate).

- A. Size large, 20-24 mm. long, elytral costæ not (in general) parallel (subparallel in *H. moniliferus*).
- B. Form widely ovate, margins wide.
- C. Elytra widest at base..... *consularis* Pasc.
- CC. Elytra widest at, or behind, middle.
- D. Colour brilliant nitid-black, prosternum not carinate.  
*spinifer*, n.sp.
- DD. Colour subnitid-brown, prosternal carina sharp.  
*moniliferus* Pasc.
- BB. Form elongate, elytral margins narrower.
- C. Elytra glabrous.
- D. Elytral costæ extending nearly to apex of disc, prosternal carina bifid at apex..... *ellipticus* Lea.
- DD. Elytral costæ terminating on apical declivity, prosternal carina subobsolete anteriorly..... *approximatus*, n.sp.
- CC. Elytra sparsely pilose, hairs long..... *comatus*, n.sp.
- CCC. Elytra squamose.
- D. Anterior prothoracic processes rounded at apex, elytral costæ terminated on apical declivity..... *squamosus* Pasc.
- DD. Anterior processes acute at apex, elytral costæ continued almost to apex..... *Derbyensis* MacL.
- AA. Size medium, 15-18 mm. long. Elytral costæ parallel or nearly so.
- B. Form widely ovate.

- C. Prothoracic carina forming a double, or triple, curve (seen sideways).
- D. Form rather flat.
- E Margins horizontal, equally wide all round. .... *castor* Pasc.
- EE. Margins slightly concave and undulate, costæ more approximate ..... *Georgiei*, n.sp.
- DD. More convex, explanate margins of elytra narrowing to apex.
- E. Anterior prothoracic processes blunt.
- F. Upper surface strongly bristled.
- G. Bristles red ..... *Mastersi* Pasc.
- GG. Bristles black.
- H. Pronotum nearly smooth..... *Gileinii*, n.sp.
- HH. Pronotum pustulate..... *occidentalis*, n.sp.
- EE. Anterior prothoracic processes acute (falcato) { *Perronii* Boisd.  
  { *falcatus* Pasc.
- BB. Form less widely ovate.
- C. Prothoracic carina forming a single curve (seen sideways).
- D. Surface not bristled..... *rugosipennis*, n.sp.
- DD. Surface densely bristled..... *opacicollis*, n.sp.
- BBB. Form elongate-ovate.
- c. Elytral costæ entire.
- d. Surface nearly smooth..... *Macleayi* Brème.
- dd. Surface with tufts of long hair..... *sparvus*, n.sp.
- ec. Elytral costæ broken into nodules posteriorly..... *Franchi*, n.sp.
- AAA. Size small, 8-11 mm. long.
- b. Elytral costæ parallel.
- c. Anterior prothoracic processes overlapping..... *granulatus* Lea.
- cc. Anterior prothoracic processes not meeting..... *Haagi* Dohrn.
- bb. Elytral costæ not parallel..... *Hopei* Brème.

Section iv., at present contains only one species, herein described as *H. crenatipennis* mihi.

Section iv. *Elytra quadricostate.*

*crenatipennis*, n.sp.

Section v. — *Elytra tuberculate.*

Consists of four described species, but they are perhaps the most difficult of all to identify or classify with any real definiteness. Taking them in order of priority of description, they are *H. ovatus* Guérin, *H. tuberculatus* Brème, *H. echinatus* Hope, and

*H. horridus* Blackb. So far as I am aware, this group is confined to New South Wales and Victoria, but enjoys a wide range over this area. I have examined a very large number of specimens, and have twenty-two specimens before me now. It may be doubted whether the four are not merely geographical varieties of the same species; but for the present I will note my own observations on the differences noted in the types inspected, and in the specimens observed.

*H. ovatus* Guér., is the largest of the four, and the only one having distinct costæ, two on each elytron, the first a short scutellary costa, the second more or less parallel to this, both being uninterrupted or non-nodulose, at least, on basal part of disc. The outside edge of elytra (seen sideways) is very thin and laminate, but a little recurved; while the extreme edge of the prothorax is wide, convex, and so much recurved as to be nearly horizontal. My note on inspecting the specimen in the Hope Museum is, that it is only a variety of *H. echinatus* Hope. My largest specimen, from Cowra, N.S.W., measures  $17 \times 12$  mm.; other specimens from Mulwala and other parts of New South Wales are normal in size.

*H. tuberculatus* Brême.—I do not think I have seen the type of this, but, from de Brême's figure, it appears to be the form commonly found throughout the whole of New South Wales. I have specimens from Mudgee, Muswellbrook, Camden, Guntawang, Baan Baa, etc., varying in length from  $10\frac{1}{2}$  mm. to 14 mm. They can be distinguished from the other three species by Mr. Blackburn's test as to the comparison of the extreme margins of the prothorax and elytra. Alone of the group, this species (if I am correct in my identification) has the extreme edges of the elytra, seen sideways, more or less concave or flat, and similar to, though sometimes slightly narrower than, those of the prothorax, which are narrower and much less upturned than in *H. ovatus* Guér. The tubercles are also smaller than on the other species, and, in general, round.

*H. echinatus* Hope.—The type or ootype of this is probably the specimen referred to by Sir W. Macleay (These Proceedings,



Ser.2, Vol.ii, p.649) and which I have closely examined in the Macleay Museum. It is labelled *H. echinatus* Macleay, N.S.W. I have specimens exactly like it from Mount Macedon and other parts of Victoria. The edges of the elytra are thin, as in *H. ovatus* Guér.; those of the prothorax wide and upturned. The tubercles of the elytra are larger than in *H. tuberculatus* Brême, the short scutellary costa is nodulose or broken, and the large seriate punctures are more evident than in the other species. The form is in general narrower than in *H. tuberculatus*. The figure given by Hope is of little use for distinguishing the main points of difference between this and the other species.

*H. horridus* Blackb., is not aptly named, since *horridus* suggests spines, while the description evidently refers to "tubercles" only, on the elytra. These tubercles are larger than in any of the preceding. I have three specimens, taken by myself near Mt. Kosciusko, which correspond to Mr. Blackburn's description. The author only states of the locality that "the South Australian Museum possesses a single specimen, probably taken in South Australia." The extreme edges of the prothorax and elytra are as in *H. ovatus* Guér., and *H. echinatus* Hope.

#### Section v. *Elytra tuberculata*.

- A. Edge of elytra (seen sideways) concave or flat ..... *tuberculatus* Brême.  
 AA. Edge of elytra (seen sideways) laminate.  
 B. Elytra costate. .... *ovatus* Guér.  
 BB. Elytra not costate (in general).  
   C. Elytral tubercles small..... var.(?) *echinatus* Hope.  
   CC. Elytral tubercles large.....var.(?) *horridus* Blackb.

#### HELEUS PERBONII Boisd.

##### *H. falcatus* Pasc.

Widely oval, convex, pitchy black, prothorax opaque, elytra rather nitid, antennae and tarsi piceous, the former reddish at apex, underside black, slightly nitid.

*Head*: labrum emarginate, epistoma nearly flat, truncate in front, angles widely obtuse, epicranium not much depressed, eyes approximate, surface minutely shagreened, antennae much shorter

than prothorax, third joint as long as fourth and fifth combined, 8-10 oval and flattened, eleventh obovoid and longer than tenth. *Prothorax* (5 x 9 mm.) widest at base, length measured to apex of anterior process, sides narrowing in a curve from base to apex, a little sinuate anteriorly, posterior angles acute, slightly produced and deflected at the tips, anterior processes narrowing to a point, gradually rising above the plane of prothorax and exactly meeting vertically above the middle of the head (not produced in front of head) with their edges vertical at their junction [this character is not constant, and subject to variation], each process separately rounded or falcate, and recurved at the apex; foliate margins wide, concave, separation from disc marked by sulcate depression in front only, extreme border thick and reflexed from above (seen sideways, thin and continuous with under surface). Disc convex and carinate, the line of carina, seen sideways, forming a triple curve, or trisinate line, the posterior equiangular triangular tooth much the most prominent part, with posterior edge oblique and continuous to base; surface of disc and margins closely pustulose, base closely fitting elytra and crenulate. *Scutellum* transversely semielliptic, finely punctured and non-carinate. *Elytra* as wide as long (10.5 mm.), oval, widest behind middle, slightly narrower than prothorax at base, apex a little produced, shoulders obtuse-angulate, the angle emphasised by strongly raised border ending abruptly at middle of basal side, vertical near shoulder but gradually becoming explanate at apex; foliate margins of same width as those of prothorax at base, gradually narrowed and obsolete at apex, slightly gibbous at base, convex behind, extreme border reflexed and much thinner than that of prothorax (seen sideways it is much thicker than it and convex, the lower edge carinate and below the plane of undersurface); disc tricostate, the suture and two subparallel costæ strongly raised; of these the suture less raised, continuous from base to apex, the other two little divergent at base, very slightly convergent and abruptly terminated on apical declivity, crenulate on both sides; surface lineate-punctate, the part between costæ containing two rows of large punctures at intervals of

about the diameter of one of them (besides the large punctures on the sides of the costæ), between costæ and margins the punctures much smaller, but still lineately arranged, disc and margins clad with very short reddish hairs, on each side a line of spiniform pustules situated considerably above the junction with margins; prosternum convex, cylindrical between coxæ; abdomen smooth, minutely punctured; tibiæ hairy, apical spines small. *Dimensions*—13.15 × 9.10.5 mm.

*Hab.*—South Australia and Kangaroo Island.

*HELÆUS SPINIFER*, n.sp.

Widely elliptic-ovate, glabrous, moderately convex, entirely black; the whole, except head and margins of prothorax, brilliantly nitid, antennæ piceous, tarsi clothed with red tomentum.

*Head*: labrum emarginate, fringed with red hair; epistoma truncate, angles rounded, with strongly raised ridge separating epicranium from forehead continuous with frontal ridge (between the eyes); epicranium depressed and sparsely punctured; eyes large, transverse, separated by space less than 1 mm.; antennæ extending to the base of prothorax, third joint cylindrical, as long as fourth and fifth combined, succeeding joints successively wider to apex. *Prothorax* (8 × 14 mm.), length measured to apex of anterior process, width at base, sides moderately rounded, faintly sinuate in front, incurved and produced posteriorly into a distinct tooth, anterior processes just meeting, regularly narrowing, on both edges, at the apex into a U-shaped termination, enclosing head in an oval of 3 mm. diameter; foliate margins wide (margins: disc as 3:7), raised near base, rather flat and obliquely raised in front, extreme margin vertically raised and strongly thickened posteriorly, surface of margins opaque, very minutely roughened and separated from disc by irregular depression. Disc convex, depressed along anterior edge (extreme border slightly raised); edge, seen sideways, thin; two large foveate depressions near base, strongly carinate at centre, carina not continued to apex and terminated posteriorly by a long spiniform tooth, produced obliquely backwards, surface smooth and

impunctate, curve of carina (seen sideways) continuous. *Scutellum* semielliptic, raised in middle. *Elytra* as wide as long (16 mm.), widest behind middle, of the same width as prothorax at base, sides gradually widened, widely rounded at apex, humeri (seen from below) obtusely angulate; seen from above, the angle formed by thickened raised border is rounded; foliate margins as wide as those of prothorax at base, only slightly narrowed at apex, gibbous at shoulders, horizontal at sides, more convex at apex, extreme border very thick and strongly reflexed, edge (seen sideways) deeply concave and much wider than that of prothorax. Disc convex, apparently impunctate, separated from margins by a row of round pustules continuous from behind humeral callus almost to apex of costæ; with strongly raised costa on each elytron extending from base to apex of disc, diverging at base, gradually converging on steep apical declivity, again a little divergent near apex (3.5 mm. apart at base, 2 mm. distant at apex), costæ crenulate on sides, the suture slightly raised from middle to apex, sulcate on each side, the depression widening towards apex into a concavity between suture and costæ, and containing a single line of punctures rather widely separated. Abdomen finely, not deeply punctured, underside of legs opaque and slightly rough, tibiæ coarsely punctured, sparsely clad with red recumbent hair and strongly bispinose. Prosternum convex in front, cylindrical between coxæ. *Dimensions*—22 x 16 mm.

*Hab.*—West Australia.

A single specimen, probably female, in the French Collection of the National Museum, Melbourne. It is very distinct from any described species by its combination of large size and polished ebony-black colour. Though widely differing from *H. consularis* Pasc., it is perhaps nearer that species than to others, but may readily be distinguished by its more brilliant polish, by the spiniform prothoracic carina, by its more parallel elytral costæ, and by its widely oval form. (*H. consularis* is obovate, widest at shoulder, *H. spinifer* widest behind the middle). Type in the National Museum, Melbourne.

## HELEUS APPROXIMATUS, n.sp.

Elongate-ovate, glabrous, piceous-black, subnitid, almost impunctate above, underside piceous with margins and legs lighter colour.

*Head* with labrum slightly emarginate and fringed with reddish hair, epistoma truncate and reflexed, minutely granulose, eyes almost contiguous, centre of forehead in front of eyes depressed, antennæ rather slender, joints 9 and 10 shorter but not wider than the rest, eleventh elongate-ovoid, mentum cordate and longitudinally carinate. *Prothorax* transverse ( $8 \times 11\frac{1}{2}$  mm.), widest at base, uniformly narrowing to apex, much less convex than *H. ellipticus* Lea, margins widely reflexed, thickly bordered at base, border becoming gradually obsolete towards apex, anterior angles acute and overlapping at the points, posterior angles acute, markedly dentate and produced downwards, anterior processes minutely punctate near the edge. *Disc* impunctate, with central carina more uniform and less elevated than in *H. ellipticus*, not extending to either margin, and less strongly "beaked" behind; base strongly trisinate, with margin closely serrated. *Scutellum* widely triangular, concave and defined by raised border, punctulate. *Elytra* ovate, subparallel on the anterior half, a little narrower than prothorax at base, humeral angles subdentate, obtuse (about  $100^\circ$ ), concave margins less wide than those of prothorax, with reflexed border on sides only continued for a short distance at base and becoming gradually attenuated to a thin line at apex; edge of border (viewed sideways) strongly concave, this lateral channel narrowing from base to apex, but distinctly narrower than in *H. ellipticus*. *Disc* with suture evidently carinate towards apex, less so anteriorly (except on sides of scutellum), with two strongly raised carinæ on each side of the suture, these carinæ finely sinuate when viewed closely, slightly curved outwards at the middle, and terminated near the summit of the apical declivity; a row of small lateral pustules beginning behind the humeral callus and obsolete on apical curve. *Prosternal keel* moderately raised, not notched, but

punctulate between the coxæ, and produced hindward into a distinct subvertical tooth; anterior segments of abdomen with longitudinal lines of very minute granules, apical segments finely rugosely punctate; legs rugose and finely granulated on the outside, thickly clothed on the inside with reddish hair. *Dimensions*— $20 \times 11.5$  mm.

*Hab.*—Onslow, West Australia.

A single specimen (♀) kindly sent by Mr. C. French. An evident ally of *H. ellipticus* Lea, it can readily be separated from that species by (1) much less convex form; (2) more narrowly pointed prothorax with more acute anterior angles; (3) dentate posterior angles to prothorax; (4) elytral carinæ terminated considerably before the apex; (5) slenderer antennæ, especially of apical joints; (6) prosternum less raised in front and dentate behind. Type in author's coll.

#### HELÆUS COMATUS, n.sp.

Elongate-ovate, black, nitid; antennæ, palpi and tarsi piceous red; whole upper surface finely, sparsely and irregularly granulose, each granule bearing a long whitish hair.

*Head* immersed in thorax beyond the eyes, flat, minutely punctate, and granulose, labrum emarginate, epistoma subtruncate; antennæ long, extending to base of prothorax, third joint about equal to fourth and fifth combined, three apical joints globular and successively larger, eleventh much the largest. *Prothorax* ( $7 \times 9.5$  mm.), length measured to the apex of anterior process, width at base, anterior processes acute, just meeting at tips, and enclosing head in a transverse oval 3 mm. wide, sides arcuate anteriorly, a little sinuate behind, posterior angles very acute, dentate with tooth deflexed, base strongly trisinate, central lobe produced backward; foliate margins wide (especially the anterior portion), inclined obliquely upwards, posteriorly reflexed at extreme margin, surface minutely and sparsely granulose and pilose only near base; extreme margin (seen sideways) widely concave, becoming laminate at apex, distinctly punctate, basal edge of margins and disc strongly serrated; disc

moderately convex, central carina interrupted anteriorly and not extending to apex, at base forming a widely rounded hump, with posterior extension produced downwards into a distinct "beak" overhanging the base; seen from above this carina posteriorly widened, convex, and punctate. *Scutellum* triangular, strongly ridged in the middle. *Elytra* ( $12 \times 9.5$  mm.), base trisinate and serrated, less wide than prothorax, humeri rectangular and dentate at their lower margin, the upper raised margin more obtuse and rounded, sides subparallel, slightly widened behind the middle, a little acuminate at apex; foliate margins moderately wide and horizontal at base, becoming narrow, subvertical, and continuous with disc before middle, extreme border thickened, crenulate and little raised, seen sideways concave, wide as that of prothorax at base, gradually narrowing to apex, with double border thick and nitid. Disc depressed at base, convex behind, bicostate, a thick crenulate carina on each elytron, these 3 mm. apart, outwardly directed in front, subparallel for the greater part, narrowed, converging, and abruptly terminated on apical declivity, suture nowhere raised, a line of round pustules extending from behind shoulder, then growing smaller hindwards and becoming obsolete before apex. Prosternum widely carinate, carina transversely notched, nitid, bifurcate, and terminated at base by two round shining pustules; strongly produced backwards and received into a deeply U-shaped mesosternal cavity, this cavity itself bordered by a raised notched margin, metasternum with similar but less raised carina than that of prosternum; abdomen finely granulose, interstices closely and minutely punctate, whole undersurface, legs, palpi and antennæ strongly pilose, the flavous hair longest on legs and sternum, tibiæ strongly spinose, legs (especially tibiæ) long. *Dimensions*  $19 \times 9.5$  mm.

*Hab.*—Minilya, West Australia (Mr. T. Warr).

The above very interesting addition to the genus is represented by a unique male specimen in the French Collection of the National Museum, Melbourne, and bears a label inscribed "Menilya, W. Aust., pres. by T. Warr, 1902." It is very

distinct from other members of the bicostate group, though (very superficially) nearest to *H. ellipticus* Lea. It is, however, narrower, in proportion to length, than *H. ellipticus*, while its detailed structure is very different. The prothoracic margins take a wide sweep forward, and the long, sparse, pale yellow hairs above, and the thicker and darker clothing beneath, make this species easily identifiable.

*HELÆUS GEORGEI*, n.sp.

Widely ovate, rather depressed, dark brown, moderately nitid, with edges, costæ, oral organs, and tarsi reddish, antennæ and tibiæ pitchy-red.

*Head* narrowly rounded in front, with epistoma reflexed and limited behind by a straight transverse suture, forehead flat, minutely pustulate, eyes approximate; antennæ extending beyond base of prothorax, third joint as long as fourth and fifth combined, 8-10 round, eleventh wider and longer than preceding, ovoid. *Prothorax*  $4 \times 10$  mm., width at base, length in middle, flat and depressed on disc, margins widely perfoliate, together half as wide again as disc, nearly semicircular in outline, faintly sinuate towards apex, base bisinuate, anterior processes overlapping, narrowing but rounded at apex, posterior angles acute and produced backward, extreme margins strongly raised, outside edge (seen sideways) concave; foliate margins increasingly concave towards apex, disc minutely punctate, pustulate and clothed with very short reddish hair (very sparsely so on margins); base and apex with thin, raised, reddish border, disc with central carina bicurved, little raised, and not continuous to base or apex. *Scutellum* raised, strongly transverse and elliptic. *Elytra* much wider than prothorax, widest at middle, foliate margins wide and slightly undulate, their planes a little inclined upwards, very little narrowed at apex, faintly punctulate; extreme edge (seen sideways) concave, slightly wider than that of prothorax, forming a reflected margin subobsolete at apex; disc with two sharp subparallel costæ strongly raised, slightly divergent at base, abruptly ending on apical declivity and narrowly separated (about 2 mm.);



suture also costate but less raised than preceding, surface of disc closely, coarsely and confusedly punctured, with two equidistant lines of punctures between the costæ and margins, interrupted and confused with the rest at base and apex, but forming with the rugose intervals two short indistinct lines near centre; a row of lateral punctures placed in a deeply indented sulcus; epipleurae and overlapping sides of sternum very coarsely punctured, with intervals rugosely vermiculate; abdomen finely rugose, with faint longitudinal strigose aspect. Legs normal. *Dimensions* 16 × 12.5 mm.

*Hub.*—King George's Sound, West Australia.

A unique specimen, female, in the Macleay Museum, labelled *H. Perronii* Boisd.; but this identification is in glaring defiance of the description and figure as given by de Brême.\* It is evidently nearest to *H. castor* Pasc., in its ovate form and depressed thorax, while it differs from that species in (1) smaller size, (2) less circular form, (3) closer elytral costæ, etc. I have named it after the veteran Curator, Mr. George Masters, while its name will also suggest its habitat.

#### HELEUS GILESII, n.sp.

Broadly ovate, convex, nitid, black above, piceous-black beneath, tarsi and apical joints of antennæ reddish.

*Head* with labrum emarginate and truncate, with rounded angles, epistoma truncate and rather flat, rounded at the sides, epicranium forming a subtriangular plate between and continued in front of the eyes on the same plane as the eyes, part between this and the epistoma rather abruptly depressed; eyes large, separated by less than 1 mm., antennæ not extending to the base of prothorax, third joint cylindrical and slender, 4-7 obconic, slightly increasing in width, 8-11 subspherical, forming a club much wider than the rest, eleventh largest and not at all pointed. *Prothorax* transverse (6 × 10 mm.), width measured at base, length

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\* The above was written before receiving the (I believe) true *H. Perronii* from Mr. Gahan. *H. Georgei* is still further removed from this species.

in the middle to apex of anterior process, glabrous, not perceptibly punctured on disc, minutely bristled on margins, widest near base, then narrowed, a little sinuately to the apex, slightly incurved at the posterior angles; anterior processes acute, overlapping at the points, enclosing the head in a circle of 2 mm. diameter, posterior angles acute and dentate, foliate margins together about half the width of disc, gibbous at the base, concave anteriorly, with the edge thin, rounded and raised, continuous with the under surface; base strongly trilobed, the discal lobe curved backwards and meeting the marginal base in a wide but distinct angle, the marginal base coarsely serrated; base and apex not apparently margined. Disc with central carina not reaching apex, rising strongly in a double curve and forming a large blunt tooth near base, with its posterior outline subvertical (not beaked or overhanging). *Scutellum* transverse, triangular, and depressed. *Elytra* nearly as broad as long (12.5 × 11.5 mm.), widest behind middle, humeral angle defined and obtuse, sides a little incurved at shoulder, then very gradually widening to apical third, widely rounded at apex, the apices of elytra very slightly produced and separately rounded, foliate margins as wide as those of the prothorax at base, narrowing to half-way, and narrowest at apex, subhorizontal at base, more oblique and concave towards apex, with extreme border strongly raised and infolded at base; border reflected at sides, nearly flat at apex, with edge (seen sideways) flat, slightly grooved, and wider than edge of prothorax, but narrowing at extreme apex. Disc convex, coarsely punctured, with some indications of a linear arrangement, and, together with margins, thinly clad with fine short black bristles; the suture, and one on each side of suture, forming three equally raised parallel costæ; of these the sutural costa is continued from base to apex, the discal costæ extending from base to the summit of the apical declivity and distant about 3.5 mm. apart, all three costæ having a line of large punctures at each side on the elytra. *Abdomen* more densely but less coarsely punctured than elytra, legs (especially tibiae) rugose and finely granulated and bristled, apex of tibiae strongly bispinose (longest on the fore tibiae), tarsi

beneath clothed with reddish tomentum. Prosternum slightly convex; with raised border extending around the coxæ, hind margin subvertically produced; submentum closely punctured. *Dimensions* 18 × 11.5 mm.

*Hab.*—South Perth, West Australia; collected by Mr. H. Giles.

Four specimens are before me, one ♂, the rest, I think, ♀, sent by that very observant naturalist, Mr. Henry Giles, of the Zoological Gardens, South Perth, to whom I am much indebted for these and other specimens, and after whom I name this insect. From *H. rugosipennis* Carter, it differs in its broader form, smoother and more nitid prothorax (with its double humped carina), and the bristly clothing of its elytra. Type in author's coll.

*HELEUS OCCIDENTALIS*, n.sp.

Wider and more convex than the preceding (*H. Gilesii*), and of a more nitid black on the upper surface.

*Head* wider than in *H. Gilesii*, with upper surface dotted with small pustules, triangular impression in front of eyes bisected by distinct longitudinal sulcus, extending to base of eyes; antennæ stouter, especially the basal joints. *Prothorax* (6 × 11 mm.) bearing minute setigerous pustules on disc and margins, widest at base, narrowing more abruptly, and more sinuate towards apex than *H. Gilesii*; posterior angles acute, dentate and deflexed at point, but not incurved, anterior processes widely rounded and overlapping, enclosing the head in an ellipse whose major (transverse) axis is 2 mm. Width of combined margins to disc at base as 5 : 6, these more concave than in *H. Gilesii*, with the edge more thickened and not continuous with under surface; base trilobed, marginal base very finely serrated, not margined. Disc with central carina not reaching apex, more strongly raised in a double hump (i.e., with frontal declivity much steeper) and forming a high rounded tooth near base, with posterior outline less vertical than in *H. Gilesii*. *Scutellum* transverse, triangular, and raised. *Elytra* broader than long (11 × 12.5 mm.), widest behind middle, humeral angle rounded, not defined, sides scarcely incurved at base, apices separately rounded, foliate margins wider than those

of prothorax at base, gradually narrowing to apex, but flatter than in *H. Gilesii*, extreme borders subvertical or slightly outwardly oblique, with edge (seen sideways) concave, wider than the edge of prothorax and perceptibly wider than in *H. Gilesii*, especially near apex. Disc very convex, finely and more closely punctured, with no indication of a linear arrangement except by two faint lines of larger punctures equally and widely separated; the punctures bearing short black bristles; three strongly raised costæ arranged as in *H. Gilesii*; discal costæ 4 mm. apart, the junction of margins with disc also indicated by a slightly raised interrupted costa, outside which is a row of large lateral punctures (much larger than any on *H. Gilesii*). *Abdomen* very minutely and densely punctate, under side of margins with larger punctures (in both cases finer than in *H. Gilesii*); otherwise similar to *H. Gilesii*. *Dimensions* 17 x 12.5 mm.

*Hab.*—Shark Bay, West Australia.

Two specimens, both ♂, are before me, sent by Mr. C. French, F.L.S. A close ally of *H. Gilesii* mili, it differs most in its shorter, wider form, greater convexity, much more abrupt apical declivity of discal parts, its wider and more horizontal elytral margins, more nitid surface, finer and more irregular elytral sculpture, besides the other differences noted above. Type in author's coll.

*HELEUS RUGOSIPENNIS*, n.sp.

Oval, convex, almost glabrous, subopaque black above, piceous and more nitid beneath.

*Head* nearly round in front, rather narrow, epistoma not convex, epicranium little depressed, antennal orbits not prominent, eyes approximate, antennæ much shorter than prothorax, third joint shorter than fourth and fifth combined, apical five joints considerably wider than preceding, seventh and eighth larger than ninth and tenth respectively, these two short and transversely elliptic, eleventh largest and oval. *Prothorax* (of ♂) 5 x 8 mm., widest at base, length measured to apex of anterior

process, sides sinuately narrowed to apex, posterior angles acute, produced a little backwards and downwards into a short tooth, anterior processes slightly overlapping, hollowed and narrowly rounded at extreme point, enclosing head in a circle of less than 3 mm. diameter; foliate margins concave, strongly reflexed at border, edge (seen sideways) thin and continuous with under surface; disc convex, with central carina rising in a single curve to its highest point near, but not at apex, posterior edge of carina descending in a steep declivity to base, head and prothorax minutely and closely pustulose, base strongly trisinuate, edge not crenulate. *Scutellum* transversely triangular and a little raised in middle. *Elytra* (9 × 9 mm.) ovate, widest at middle, of same width as prothorax at base, apex of each elytron separately rounded; shoulders obtusely angulate, foliate margins as wide as those of prothorax at base, narrowing to apex, concave for the greater part but horizontal, not gibbous at base; extreme edge reflexed, seen sideways narrow, convex, of same width as those of prothorax and continuous with under surface; surface of margins sublaevigate. Disc very convex, tricostrate, with the suture and two subparallel costæ forming strong ridges of almost equal height; sutural costa continuous from base to apex, the other two scarcely divergent at base and very little convergent and abruptly ending on apical declivity, crenulate on sides; between these costæ and the sides are two subobsolete costæ continuous from base almost to apex, the junction of disc with margins marked also by crenulate impression, on the outside of which is the line of large lateral punctures: whole surface of disc coarsely and irregularly foveate-punctate, without linear arrangement, intervals coarsely, subreticulately rugose. Prosternum little raised, posterior process flat and sulcate at sides, abdomen minutely shagreened, under side of femora smooth, tibiæ rugose, not hairy, apical spines small. *Dimensions*, ♂ 14 × 9 mm.; ♀ 16 × 10 mm.

*Hab.*—Bridgetown, West Australia (Mr. H. M. Giles).

Two specimens are under observation, for which I am indebted to the enthusiasm and generosity of Mr. Giles. The species is

distinguished by its almost glabrous surface, besides the other characters described above. With a strong lens, very minute bristles may be detected on the elytra, but they are in marked contrast to the evident clothing of all the preceding species described by me. The female specimen is larger, and has its anterior processes more recurved and a little wider at the apex than the male, so that the apical part of the head is covered; in the male, they are more extended, so that there is some clear space between them and the front outline of the head. Types in author's coll.

*HELEUS OPACICOLLIS*, n.sp.

Broadly ovate, very convex, head and prothorax opaque, elytra subnitid, upper and lower surface black, antennæ and palpi slightly piceous.

*Head* with labrum narrowly truncate in front, straight at sides, epistoma truncate, not reflected, and arched (from front view); sides a little raised, widening in a straight line to the antennal orbits, front with epicranium raised, anterior portion depressed to the plane of the epistoma, without suture to define these regions; the whole upper surface of head and prothorax closely and distinctly granulose; antennæ not extending to base of prothorax, third joint subcylindrical, as long as the fourth and fifth combined, 4-7 wider and subtriangular, 8-10 much wider than the preceding and round (8th larger than 9 or 10), eleventh largest of all, widely ovoid. *Prothorax* more convex than in *H. Gilesii*, glabrous, nearly twice as wide as long (5.2 x 10 mm.), foliate margins more concave, rugose and narrow, width of disc to combined margins as 3 : 2, the anterior processes rather narrow, widely overlapping, acute and incurved (falcate) at the points, enclosing the head in a transverse ellipse (1.5 x 3 mm.), sides gradually narrowing from base to apex, with apex more blunt and incurved than in *H. Gilesii*, a little incurved at posterior angles, these acute, dentate, and overlapping elytra; outside edge raised and reflexed (seen sideways, very narrow and round), basal margin not apparently serrated. Disc very convex, with central carina starting near apex, rising to an elevated flattened hump.

near base, with posterior outline steeply sloping (not overhanging) to the base. *Scutellum* transverse, triangular, and granulose. *Elytra* very convex, as wide as long (11 mm.), widest behind middle, shoulders bluntly rounded, foliate margins wide and concave at base, strongly narrowing towards apex, becoming horizontal in that region, extreme edge (seen sideways) wider than that of prothorax, concave and gradually narrowing from base to apex, obsolete behind; margins and disc closely set with short upright black bristles. Disc strongly tricostate, sutural costa extending from scutellum to apex; two parallel costæ, one on each elytron (3.5 mm. apart), more strongly raised than sutural costa at base, abruptly ending on apical declivity, coarsely and irregularly punctulate on disc, margins impunctate, with faint indications of raised longitudinal lines on disc outside costæ, and a more or less continuous line of raised linear granules on the outside of disc, forming a low crenulate costa. *Abdomen* very finely and longitudinally rugosely punctate; under side of margins coarsely punctulate, prosternum transversely rugose, submentum finely granulated; legs (especially tibiae) thickly granulated, tibial spurs much shorter than in *H. Gilesii*; prosternum convex, with posterior process rounded and margined, and only slightly produced. *Dimensions* 16 x 11 mm.

*Hab.* -- Perth, West Australia.

A single specimen (♂), sent by Mr. W. Duboulay. A specimen in the Macleay Museum is paired with another species labelled *H. Mastersii* Pasc. It is superficially like both *H. Gilesii* and the specimen from Salt River, W.A., which, Mr. Masters assures me, is a cotype of *H. Mastersii* Pasc.; but the last has red bristles (though described with black), and the side edge of pronotum is concave and equally as wide as that of the prothorax; with wider anterior processes to the prothorax, and wider lateral margins; *H. opacicollis* is strongly differentiated from *H. Gilesii* by its opaque granulated head and prothorax, *inter alia*.

#### HELIUS SPARSUS, n.sp.

Elongate-ovate, subparallel, depressed, subnitid, piceous-black, with foliaceous margins yellowish on the prothorax and in

patches on the elytral margins; antennæ, palpi, and tarsi reddish, with apical joints of the first lighter.

*Head* finely rugose, with only a portion of the eyes and forehead not covered by the prothoracic processes; labrum red, truncate and protuberant; eyes round, large, flat, close, and coarsely faceted; antennæ nearly extending to base of prothorax, third joint cylindrical and thinner than the succeeding, as long as the fourth and fifth combined, 4-8 obconic, gradually more transverse, 9-10 widely oval, eleventh largest and spheroidal. *Prothorax* transverse (5 x 9 mm.), glabrous, widest at base, narrowed semi-circularly to apex, anterior processes widely truncate at apex, and just overlapping, the perforation enclosing head forming nearly a complete circle of 2 mm. diameter, with the basal margin a little intrusive; foliate margins wide, with raised thickened border obliquely flattened on its edge, posterior angles acute and closely fitting base of elytra; margins finely punctured and granulose, base of margins strongly serrated; disc rather flat, minutely rugose, with central carina uniformly raised (not denticiform) from base almost to apical margin, the former thinly, the latter not perceptibly bordered. *Elytra* parallel for two-thirds of their length, longer than broad (11 x 10 mm.), more convex than prothorax, with flattened foliate sides of the same width as those of the prothorax, slightly narrowed at apex, shoulders rather square with the extreme angle rounded, apex squarely rounded, border strongly raised, with oblique edge of the same width as that of prothorax and a little concave; disc furnished with two strongly raised subparallel costæ very close together (less than 1 mm. apart), extending from the base almost to apex of disc, a little divergent at base, and convergent and closely approximate at apex, near which they abruptly end, suture faintly carinate near apex only; outside the costæ on each elytron four rows of thinly arranged tufts of long piceous hair, the external rows closer than the rest, each tuft consisting of two or three coarse upright hairs curved at the tips, with about fifteen such tufts in a single row, otherwise glabrous; disc coarsely and irregularly lineate-punctate. *Abdomen* glabrous,



and rugose with a tendency to longitudinal strigosity, prosternum distinctly carinate, produced hindward and rounded at hinder apex. Legs very rugose, inside of tibiæ and under side of tarsi lined with short reddish hair. *Penis* longitudinally sulcate above. *Dimensions* 16 × 10 mm.

*Hab.*—Onslow, West Australia. Sent by Mr. C. French, F.L.S.

A single specimen, ♂, entirely differing from all the other tufted species, with its strongly raised elytral costæ more approximate than in any of the costiform species, though nearest to *H. Macleayi* Brême, in this respect. The yellow markings on the margins may be individual and due to immaturity, but their transparency is due to the thin structure of this part. Type in the author's collection. There are two specimens in the French Collection, Melbourne Museum.

#### HELÆUS FRENCHI, n.sp.

Elongate-ovate, black, very nitid and smooth, antennæ and legs piceous, the former with apical joints red.

*Head*: labrum evident, epistoma truncate in front, with blunt angles, sides a little raised towards the antennal orbits, limited behind by a straight transverse ridge; behind this the front triangularly raised, the triangle defined by raised impression with apex between the eyes, its base formed by transverse ridge; this triangle depressed in the middle. Eyes nearly contiguous, large and oblique. Antennæ at rest not reaching base of prothorax, third joint less than fourth and fifth combined, 4-7 obconic, 8-10 round, eleventh ovoid. *Prothorax* transverse (6 × 8 mm.), circularly emarginate, disc rather flat except at the strongly raised central carina, sides angularly raised, so that (viewed sideways) the outside margins are considerably higher than the discal carina; widest at base (in ♀ slightly in front of base), then gradually arcuately narrowing (a little sinuate anteriorly) to apex; anterior processes hollow, terminating in a rounded point, just crossing (in ♀ not quite meeting), posterior angles acute, produced backwards into a blunt tooth (viewed sideways, these denticulate angles, though deflexed at the apex,

are seen to be raised above the rest of the margins); margins wide with border strongly raised and reflexed, generally concave, especially near border, with a convex swelling within at about half-way; surface of margins a little transversely wrinkled. Disc slightly concave anteriorly, raised posteriorly, finely punctured, punctures more evident towards the sides; central carina two-lobed, anterior part not extending to apex, with outline low and uneven, posterior lobe much more raised into a round protuberance with its hinder edge subvertically terminated some distance from base. *Scutellum* very transverse and not prominent. *Elytra* narrowly oval, convex longitudinally and transversely; as wide at base as prothorax, then gradually enlarged to behind the middle. Shoulders prominent, obtuse, and reflexed; explanate margins much wider in front than behind, strongly reflected and deeply channelled at junction with disc, concave at humeral region, with two raised callosities occupying the full width of margins, the anterior of these more prominent and ridged than the posterior; border of margin itself rather widely reflexed and vertical. The border itself (viewed from the side) a little concave, with a fine sulcus defining the lower rim, this also deflected below the undersurface. Disc with suture carinate throughout, and two strongly raised subparallel costæ, one on each side of and rather close to the suture, the space between them widening a little at base, the costæ broken up into denticulate nodules behind and terminated on reaching apical declivity; about half-way between the costæ and lateral gutter is a short row of shining pustules, obsolete at base and apex, a second row of closer and smaller pustules on the discal side of gutter itself. A row of punctures along each side of sutural carina and costæ, and a row of larger punctures at sides of disc, the disc itself (between the costæ) and explanate margins minutely punctulate. Under side of margins of prothorax rather rugosely, of elytra coarsely punctulate, punctures round; prosternum with epimera finely transversely strigose, prosternal process with prominent subcylindrical keel, received into mesosternum by semi-circular groove; abdomen finely rugose, scarcely punctulate and

glabrous; femora and tibiae finely punctured, tibiae very sparsely and tarsi moderately clothed with reddish hair, tibiae armed with two short spines at apex. (In ♀, hind tibiae perceptibly longer).  
*Dimensions* ♂ 17 × 9.5; ♀ 20 × 10.4 mm.

*Hab.*—Phillips River district, West Australia.

I am indebted to that enthusiastic and indefatigable collector, Mr. C. French, of the Victorian Department of Agriculture, for a pair of the above distinct species, which I have great pleasure in dedicating to him in appreciation of his services to entomology. While belonging to the same group as *H. echidna* White, and *H. Macleayi* Bième, it differs markedly from each; the elytral costae of *H. Frenchi* replacing the spines of the former, while the costae of the latter are much less prominent, and not broken up into teeth behind, with the many other differences shown above. Types in the author's coll.

*HELEUS CRENATIPENNIS*, n.sp.

Oblong, subparallel, opaque, rusty-brown, thickly clothed with squamose pile above, surface beneath pile and underside opaque, pitchy-black, tarsi reddish.

*Head*: labrum narrowly produced, epistoma rounded and slightly raised, separated from forehead by arcuate ridge, front convex; eyes widely transverse and narrow, separated by a space equal to the width of an eye (diameter of minor axis), eyes bordered by smooth black surface ovally widened in front. Head as well as the prothorax and elytra thickly clothed with short brown squamosity. Antennae piceous, much shorter than the prothorax, third joint not as long as the fourth and fifth combined, scarcely enlarged towards apex, with four apical joints rounded, eleventh bluntly pointed. *Prothorax* transverse (6 × 8 mm.), widest at base, thence arcuately regularly narrowed to the anterior processes, the latter narrowly acute, not furrowed in the middle and not quite meeting; posterior angles acute (about 75°) and very little produced backwards; foliaceous sides wide, slightly deflexed at base, their plane gradually rising and border more reflexed anteriorly. Disc moderately convex and strongly carinate

in the middle, carina interrupted about half-way by depression, with its hinder lobe (seen from the side) widely oval in outline (not pointed) and produced behind. *Scutellum* triangular. *Elytra* of the same width at base and half as long again as the prothorax, shoulders rectangular and subdentate, sides a little narrowing behind shoulder, then subparallel till near apex, with border regularly crenulated, except near apex, explanate margin flat, widest at shoulder, then narrowed rather suddenly and continued of uniform width to apex; each elytron with two costæ equidistant from the suture, each other, and the sides respectively; the first strongly rising in abrupt curve from basal margin, becoming less raised posteriorly, abruptly ending on apical declivity; the second starting from well behind the shoulder, then parallel to the first and terminating at the same distance from apex; the suture itself carinate from the middle to a little behind the termination of the other four costæ. The whole undersurface thickly clothed with stout brown upright hairs, prosternum a little transversely strigose towards the sides; femora and tibiæ thickly clothed with fawn-coloured recumbent hair; tibiæ shortly spinose at the apex. *Dimensions* 15 x 8 mm.

*Hab.*—Port Darwin.

I have received, through the kindness of Mr. C. French, a single male specimen. It is quite distinct from the other described squamose species by its crenulate-sided and 5-costate elytra, *inter alia*. Type in the author's coll.

#### ENCARA LATUM, n.sp. (Fig. 1.)

Widely ovate-cordate, chestnut-brown, glabrous, moderately nitid; antennæ and palpi red, underside pale red.

*Head* transversely oval, epistoma flat, rounded, and slightly raised at sides, eyes large, separated by a space less than the diameter of one, forehead coarsely, opistoma finely punctate; antennæ extending beyond base of prothorax, third joint less than the fourth and fifth combined, apical five joints successively widening and thicker than preceding. *Prothorax* (3 x 12 mm.) length measured in middle, width at base, width between

anterior angles 3 mm., disc very little wider than each margin at base; circularly emarginate at apex, anterior angles subrectangular but blunt at tips, sides a little sinuate but rapidly widening to base, posterior angles acute and overlapping elytra, base trisinate; foliate margins wide, horizontal, with outside part (not extreme edge) slightly reflexed, narrow raised border only apparent at apex, edge (seen sideways) laminate; disc rather flat, central line indicated by depression near centre and base, two large irregular depressions near sides at base, disc and margins finely and closely punctured, with some indications of longitudinal lines on disc and oblique wrinkles on margins. *Scutellum* curvilinear or triangular, coarsely punctate. *Elytra* wider than prothorax at base, widest near middle, abruptly narrowing to apex, foliate margins very wide, slightly gibbous near humeri, and a little convex for the greater part of width, outside portion recurved, this portion narrowed and horizontal at base, wider and concave at apex; disc with suture carinate, and six obscure costæ on each elytron becoming obsolete at apex, of these the second and fourth more strongly raised; whole surface of disc and margins closely and finely punctate, and a single row of large punctures at junction of margins with disc from base to apex. *Prosternum* carinate, coxæ enclosed by dark raised border, posterior intercoxal process narrowly triangular; abdomen very nitid and minutely punctate, apical segment a little strigose, under side of margins rather coarsely punctured, tibial spurs short, hind tarsi with basal joint as long as the rest together. *Dimensions* 16 x 14 mm.

*Hab.*—North-west Australia.

A single specimen, male, in the Macleay Museum, distinguished from its congeners by its subcoardate form; the deeply immersed head, wide prothorax, and very wide elytral margins.

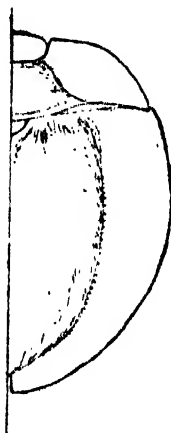


Fig. 1.

rendering its identification easy. The combined margins of the elytra are to the disc as 3:4.

*PTEROMELÆUS SOLIDUS*, n.sp.

Widely and somewhat elongate-ovate, very convex longitudinally and transversely, deep black, nitid, antennæ and apical joints of tarsi reddish.

*Head*: transversely elliptic, with labrum prominent, truncate and subrectangular, fringed with golden hair and closely punctured; epistoma strongly reflexed and hollowed within, regularly and widely rounded in front and on sides, with finely marked suture starting in front of eyes, continuing obliquely outwards to margin; eyes large, separated by a space about equal to their greatest diameter; distinctly but rather distantly punctured on front, closely punctured towards the sides. Antennæ stout, third joint as long as fourth and fifth combined, with apical four joints nearly round and wider than the rest. *Prothorax* almost smooth or almost imperceptibly punctured, moderately convex, and transverse ( $5 \times 12$  mm.), width measured at base, length in middle; deeply semicircularly emarginate at apex, bisinuate at base, sides a little rounded arcuately converging to apex, width across anterior angles 4mm.; anterior angles widely rounded (less widely than in *P. Walkeri* Brême), posterior angles acute and slightly deflexed, foliaceous margins moderately wide, outer edge reflected. *Elytra* slightly wider than and more than three times as long as prothorax, very convex, with apical declivity steeply inclined from behind the middle, apex rather sharp with each elytron diverging and submucronate at apex (bluntly produced); punctate-striate, each elytron with seventeen deep striæ, besides a short scutellary stria, containing rows of unevenly placed large round punctures, intervals convex and minutely punctured, the fourth and eighth wider and more raised than the rest, the suture also slightly raised towards apex, the outside striæ containing large punctures, about seven (largest of all), more widely separated, near the humeri; the margins narrower than those of prothorax and horizontal with narrow outside border

slightly reflexed at sides, margins narrowing behind middle (caused by slight bulging of disc); underside very nitid, strongly longitudinally strigose, apical segment of abdomen finely punctured; prosternum arched, sharply carinated throughout its whole length; tibiae and tarsi thickly clothed with fulvous hair.

*Dimensions* ♂ 20.5 × 13 mm : ♀ 22 × 14 mm.

*Hab.*—Rockhampton and Gogonga, Queensland.

I received the ♂ specimen from Mr. H. Brown, who took it at Gogonga; since then Mr. C. French has sent me another specimen from Rockhampton, which proved to be ♀. Compared with *P. Walkeri* Br., it is far more convex; seen sideways, a vertical line to its highest point from the elytral margin measures about 6 mm., while a similar line in *P. Walkeri* Br., measures 3 mm. Its outline, seen thus, is a strong oval with its posterior part steeper, the prothorax and head forming a continuous curve with the elytra. This character, combined with its deeply and almost evenly striated elytra and comparatively narrow elytral margins, make this species easy to identify. Types in author's coll.

#### PTERHELÆUS UNDULATUS, n.sp.

Widely ovate, moderately convex, glabrous, opaque, piceous, the margins paler, underside reddish, epipleuræ, antennæ, and legs ferruginous.

*Head*: labrum emarginate, ciliate in front, punctate above; epistoma widely bisinuate, with apex concave, not reflexed in front and but slightly raised at sides; angles widely rounded, limiting suture, strongly indented at sides and base, a little produced forward in middle and extending to the sides; antennal orbits almost continuous with sides of epistoma, little raised and abruptly constricted behind, front gently sloping toward suture; entirely smooth and impunctate; antennæ extending to base of prothorax, stout, third joint less than fourth and fifth combined, apical four joints transverse and oval, eleventh elongate-ovoid, bluntly rounded at apex. *Prothorax* (4 × 11.5 mm.), length measured in middle, width at base; depressed, arcuate-emarginate at apex, anterior angles widely rounded and produced to middle

of canthus, sides widening in a regular curve to near base, then a little narrowed, not sinuate, at the acutely undentate posterior angles; base trisinate, foliate margins wide (at base together nearly equal to width of disc), nearly horizontal, extreme borders very thick and round at sides (seen sideways very concave and carinate above and below), obsolete at base and very narrow at apex; disc with central line faintly indicated near base, very minutely punctate (only apparent under high power lens), with some obscure foveæ at base, the most evident of these one at middle, and one near each side. *Scutellum* transversely triangular, minutely punctate. *Elytra* widely oval, depressed in front, convex near apex, wider than prothorax at base, widest near middle, sides very gently curved and widely rounded at apex, shoulders subangulate and obtuse, foliate margins wide, subhorizontal and very gradually narrowed to apex, reflexed border not so thick as that of prothorax (seen sideways, of same or even greater width than that of prothorax, carinate below, folded above), smooth and impunctate, junction with disc marked by row of large punctures becoming smaller from base to apex, immediately above this a row of smaller punctures on sides of disc becoming obsolete behind: disc with six obscure broad and little raised costæ on each elytron, their ridges forming distinct undulating (almost 'zig-zag') lines, obsolete at apex; between these are very faint indications of minute lineate punctures, seen more distinctly near suture. Pro- and mesosternum minutely granulose, anterior coxæ with square carinate border, abdomen and femora very minutely punctate, tibiæ slightly pilose, under surface of tibiæ and tarsi clothed with golden tomentum. *Dimensions* 17 x 13 mm.

*Hab* —Stanthorpe, South Queensland.

A single specimen (♀) has been received from Mr. C. French. It is evidently distinct from all described members of Macleay's first section of the genus. Of a more widened oval form than *P. piceus* Kirby, with more convex disc, wider and more horizontal margins. The sculpture is somewhat obscure, presenting the appearance of flattened crenulate costæ, of which four are most



evident on the centre of disc. It is the smoothest of all the species in this section. The form, especially the front outline, of the epistoma is unusual. Type in the author's coll.

*PTERONKLÆUS SEPTEM-COSTATUS*, n.sp.

Elongate-oval, parallel, depressed, opaque-black, the elytral costæ and underside more nitid, antennæ and tarsi piceous.

*Head* nearly hexagonal, with front outline of epistoma a little concave and arched, upper surface of the same flat, not reflected; a slight depression (more distinct at sides) separating epistoma from front, eyes rather small, transverse, and widely separated, the whole scabrous or finely shagreened; antennæ extending to two-thirds of the prothorax, third joint shorter than fourth and fifth combined, 4-7 successively wider and rounder, 8-10 spherical, eleventh bluntly ovoid. *Prothorax* moderately convex ( $3 \times 5$  mm.), length at middle, greatest width behind middle, semicircularly emarginate at apex, with anterior angles rounded but produced in front of eyes, sides moderately rounded, gently, not sinuately, converging towards the acute backwardly produced posterior angles; base bisinuate, outside border only faintly visible at sides and apex; foliaceous margins wide and horizontal, without distinct gutter separating the disc. Disc in general (not in all specimens) showing faint traces of central channel, with two shallow foveæ at base and slight depression in scutellary region, the whole surface scabrous and shallowly punctured, presenting a shagreened appearance, slightly longitudinally rugose anteriorly, smoother on foliaceous margins. *Scutellum* triangular, finely punctured. *Elytra* flattish, very little wider than prothorax at base, and three times its length, subparallel throughout the greater part of their length, humeri rather sharply rectangular, foliaceous margins subobsolete and narrowly bordered, each elytron with three nitid equidistant costæ besides the sutural costæ, the former parallel for the greater part, the two outside (first and third) costæ approximately converging on apical declivity, the middle one shorter, ending abruptly; the sutural costæ wider, less raised, continuous to apex, bifurcating on each

side of scutellum; between this and scutellary margin a short row of about eight large punctures; between each of the costæ are four rows of regularly and closely placed round punctures; between the outside costæ and the margins the rows of punctures less regular and distinct, except a single row of larger lateral punctures; the elytral punctures largest near suture and gradually smaller towards the sides. Abdomen punctured in the middle, longitudinally strigose towards sides, whole surface of sternum scabrous like upper surface of pronotum, femora punctate, apex of tibiæ and tarsi sparsely clothed with yellowish tomentum. *Dimensions* 12-14 mm. long;  $5\frac{1}{2}$ - $6\frac{1}{2}$  mm. wide.

*Hab.*—Port Darwin, and Camoweel (North Queensland).

Sixteen specimens are before me, sent by Mr. C. French, F.L.S. Both sexes are evidently present, the males in general being smaller, a little more convex, with anterior tarsi wider. An evident member of Macleay's Section ii., Subsection 1, it is distinct from the seven described species of that group. Its nearest ally is *P. crenulatus* MacL., but that species is smaller, with its costæ nodular, "the whole having a crenulate and clathrate appearance." In *P. septemcostatus* there is a faint indication of nodulation of the costæ at the apex only in some specimens, and a still fainter suspicion of crenulation, but it is very different from Macleay's species, with which I have compared it. Type in author's coll.

#### PTEROMELÆUS PUNCTICOLLIS, n.sp.

Elongate-ovate, elytra rather depressed, prothorax opaque, elytra more nitid, brown-black, beneath reddish; antennæ black, apical joints piceous.

*Head*: epistoma finely, front coarsely and rugosely punctured, front and sides of epistoma nearly circular, not limited behind by definite suture, strongly widened and raised on antennal orbit, then abruptly narrowing to the eyes, these widely separated. Antennæ slender at base, with four apical joints much wider than preceding and flattened, 8-10 round, eleventh half as long again as the tenth, ovoid. *Prothorax* ( $4 \times 9$  mm.), length in

middle, greatest width behind middle, moderately convex, much wider at base than at apex, apex arcuately emarginate, anterior angles widely rounded, sides gradually rounded and widened till near base, then a little incurved at the falcate and acute posterior angles, these overlapping elytra, base strongly bisinuate, foliate margins wide and flat, extreme border not reflexed, margins finely roughened. Disc coarsely and closely punctured, the punctures shallow and becoming smaller at base and sides, intervals finely rugose, medial line indicated by smooth depression on centre of disc, basal foveæ represented by large shallow depressions. *Scutellum* curvilinear-triangular and sculptured as pronotum. *Elytra* (9 × 11 mm.), basal half subparallel, each with three distinct subcrenulate costæ extending from base to the apical declivity, the outermost of these thinner and more crenulate than the other two, the suture more widely but less raised throughout, the raised portion widening at the scutellary region; half-way between and exterior to these costæ are less raised lines; between the suture and the first costa are four lines of large round punctures regularly placed at intervals rather greater than the diameter of one of them, a short scutellary row of similar punctures; in the intervals exterior to the first costa the punctures indistinct, or concealed by the derm, with the exception of the rows of large punctures at the base of the costæ; foliate margins rather convex, much narrower than those of prothorax, and becoming obsolete at apex. Prosternum very convex and carinate, produced backward into a tooth, received by the metasternum, and dotted with small pustules, metasternum with strong medial sulcus, and, together with the underside of femora, finely punctured; abdomen finely longitudinally strigose and punctured, the last two segments punctured only. *Dimensions* 16 × 19 mm.

*Hab.*—North-west Australia.

A single specimen in the Macleay Museum, probably ♀. It is evidently a close ally of *P. alternatus* Pasc., and *P. depressiusculus* MacL., but the former has its prothorax "minutely punctured" and "no groove," its elytra are said to be "finely seriate-

punctate," while the latter has its prothorax similarly differentiated as to sculpture, with the elytral punctures small except near the sides.

*PTERONELÆUS NODULOSUS* n.sp.

Elongate, subparallel, flattish, opaque rusty-black above, nitid below, underside of tarsi and terminal joints of antennæ reddish.

*Head* and pronotum densely and finely shagreened, base of forehead showing a number of minute shining nodules densely packed; epistoma truncate in front, sides oblique, little raised at the antennal orbit, without definite limiting suture; eyes widely separated and transverse, antennæ much shorter than prothorax, stout, hairy, third joint subcylindric, shorter than the two following combined, 4-7 successively shorter and wider, 8-11 nearly globular, 11th little longer than 10th. *Prothorax* ( $3 \times 7$  mm.) length in middle, width at base, apex semicircularly emarginate, sides regularly rounded and securiform, wider at base than apex, anterior angles prominent but widely rounded, posterior angles produced backward and acute (about  $75^\circ$ ), base bisinuate, margins wide but not differentiated from disc, surface uniformly rough, not punctured, and sparsely clad with short reddish hair, no central line. *Scutellum* equilateral triangular, rough. *Elytra* ( $8 \times 10.5$  mm.) each with three well marked interrupted costæ extending the greater part of length, nodulose towards apex, with intermediate rows of nodules less conspicuously raised but evident, the suture itself nodulose; surface coated sparsely with short brown down, and, like the pronotum, with short reddish hair thinly scattered; without evident punctures. Underside of head, prothorax, and femora shagreened; prosternum flat, abdomen thickly and coarsely punctured, tibiae densely bristled. *Dimensions*  $15 \times 8$  mm.

*Hab.*—Roper River, North Australia.

A single specimen, probably ♀, in the Macleay Museum. It is clearly distinct from all described species, though nearest to *P. granulatus* MacL., (from Port Darwin). It is evidently much larger than Macleay's species, which is separated from it by its

differently sculptured elytra with its "rows of deep square closely placed punctures" The specimen has evidently lost much of the squamose clothing with which it appears to have been clad. It forms a connecting link between Macleay's Section ii., Subsection 1, and Subsection 2, since the smaller rows of nodules may be described as granular, while the larger form distinct costæ irregularly interrupted. There are three kinds of such rows, (i.) three equidistant interrupted costæ; (ii.) less raised lines of nodules intermediate and exterior to i.; and (iii.) still smaller lines of granules irregularly spaced but generally evident between and exterior to ii. Type in Macleay Museum

Table of *Pterohelaeus* (Macleay's Section i.).

Species of broadly ovate form, and largely expanded margins to both thorax and elytra.

- a 1. (15) Intervals of elytra costate, size large (more than 20 mm. long).
- 2. (11) Anterior angles rounded.
- 3. (19) Length to breadth about 3 : 2.
- 4. (9) Elytra at middle as wide or wider than at base.
- 5. (14) Alternate intervals of elytra more prominent.
- 6. (9) Elytra subparallel on basal half.
- 7. (7) Lateral angles of head raised..... *Walkeri* Brême.
- 8. Lateral angles nearly flat..... *rhœnæ* MacL.
- 9. Lateral angles dentate..... *cornutus* MacL.
- 10. Elytra obovate, costæ crenulate or notched..... *Brêmei* MacL.
- \* 11. Elytra not at all parallel, their margins very wide..... *costatus* MacL.
- 12. (14) Anterior angles of prothorax acutely produced.
- 13. Apex of elytra mucronate..... *spini-collis* MacL.
- 14. Apex of elytra not mucronate..... *acuti-collis* MacL.
- 15. All intervals equally raised, convexity twice that of 7.... *solidus*, n.sp.
- β Evident costæ fewer, less raised than in group a, size less than 20 mm. long (except *P. abdominalis* Loë).
- 16. (19) Elytra not parallel.
- 17. Elytra with 3 costæ (at least) evident..... *piceus* Kirby.
- 18. Elytra with a few subobsolete costæ.
- 19. Form more convex, punctures larger than in 17..... *Pascoi* MacL.

\* *P. nigricornis* Champ., is unknown to me, but seems only to present some slight colour-variations from *P. costatus* MacL., from the same region.

\*20. Elytra parallel at basal two-thirds, length to breadth as 5 : 3.

*abdominalis* Lea.

γ Disconnected and anomalous forms.

21. Elytra seriate-granulate, size large..... *raucus* Blackb.

22. Elytral costæ partly broken into series of granules..... *arcuus* Pasc.

23. Elytral costæ entire, size small, 15 mm., form very oval (length to breadth as 5 : 3) ..... *insularis* Brême.

24. Elytral costæ horizontally undulate, length to breadth as 4 : 3

*undulatus*, n.sp.

25. Elytral costæ obsolete, intervals and punctures subobsolete.

*dispar* Pasc.

26. Anterior angles of prothorax produced outwards and forwards into a round wide lobe..... *sinuaticollis* MacL.

δ27. (29) Length to breadth as 7 : 4.

28. Prothorax wider than elytra at base, alternate intervals raised.

*laticollis* MacL.

29. Prothorax not wider than elytra at base, alternate intervals not raised.

*hepaticus* Pasc.

#### Table of *Pterohelarus* (Macleay's Section ii.).

\* Form elongate or oblong-oval. Elytra more or less narrowly margined.

Subsection i. Elytra seriate-punctate; intervals more or less costate.

1. (9) Size large, 20 mm. long.

2. (12) Disc of pronotum smooth or finely punctate.

3. (5) Sides of prothorax sinuate anteriorly.

4. Upper surface strongly pilose..... *hirtus* MacL.

†5. Upper surface smooth..... (?) *Reichei* Brême.

6. (17) Sides of prothorax evenly rounded.

7. Sternum smooth..... *elongatus* MacL.

8. Sternum granulate.

9. Granules of sternum fine..... *depressiusculus* MacL.

\* *P. pruinosus* Pasc., is impossible to identify from the description; so far as it goes, however, it must be very near *P. abdominalis* Lea, which may prove to be synonymous with it. The "fine uniform whitish exudation" mentioned by Pascoe, is common to many species of the genus in fresh specimens. *P. Darwiniensis* MacL., as suggested by its author, shows a decided affinity to the insects of Section ii., in its narrow margins. It seems out of place in the above. *P. fraternus* Blackb., (if identified correctly by me), also from description, from its small size, and nearer affinity to forms like *P. vicarius* Pasc., seems more at home in Macleay's Section iii.

† *P. Reichei* Brême, is unknown to me, and may be an abraded form of *P. hirtus* MacL. At least nothing is said in the description as to pilose clothing.



and rugosely punctate, sometimes obscured by short silky derm; prosternum carinate and finely granulose, abdomen and femora closely and finely punctate, tibiae scabrous, and, with the tarsi, clothed beneath with red tomentum. *Dimensions* 13 × 11.5 mm.

*Hab.*—North-west Australia.

A single specimen, male, in the Macleay Museum, is readily distinguished from the other described species with bicostate elytra by its small size and nearly circular form.

*SARAGUS MONTANUS*, n.sp.

Moderately elongate-ovate, broad, convex, glabrous, black, nitid.

*Head* deeply sunk into prothorax, closely rugose-punctate; epistoma limited at sides by well marked suture, at base by shallow groove, apex truncate, sides widely rounded, canthus raised and separately curved, eyes widely separated, antennae with third joint shorter than two following combined, apical four joints wider and rounder than preceding, eleventh largest and flattened. *Prothorax* (4 × 11 mm.), length measured at middle, width at base; deeply emarginate in front, sides rounded and converging from base to apex, base trisinuate; posterior angles very acute and deflexed; foliate margins wide and concave, extreme margin thin and slightly reflexed, surface of foliate margins finely rugose, transversely wrinkled at border; disc irregularly and distinctly punctate, central channel only indicated by lævigata line, with two smooth impressions, one at each side near front, two transverse foveate depressions at base near scutellum, basal edge finely serrated near sides. *Scutellum* curvilinear-triangular, punctured as prothorax. *Elytra* thrice as long as prothorax, of same width at base, gradually widening to middle, broadly rounded at apex; humeri obtuse but distinct, bicostate, with two parallel carinae extending from base, abruptly ending before apical declivity, about 3 mm. apart and having rows of large punctures on each side; the suture also raised from the middle to apex; between the suture and each carina are two rows of large punctures with additional and more confused puncturation near scutellum, between each carina and the foliate



margins are eleven similar rows of punctures, these large and regular, separated by a distance of the diameter of one of them, with a larger row of punctures at the junction of the disc with the margins; foliate margin wide, narrowed at apex, flat and smooth, extreme edge narrowly reflexed (seen sideways, laminate). Prosternum carinate, abdomen black, nitid, closely and finely punctate, pleurae smooth, tibiae rough, and, with the tarsi, clothed beneath with reddish tomentum, tibial spurs short. *Dimensions* ♂.  $17 \times 12$  mm. : ♀.  $15.5 \times 11$  mm.

*Hab.*—Blackheath, Blue Mountains.

Two specimens are under examination, one undoubtedly male, the other probably female, but without any decided sexual differentiation. The former, taken by myself, the other by Dr. E. W. Ferguson, under Eucalyptus bark. In colour and general form somewhat like *S. Blackburni* MacL., but much smaller, less parallel and convex than that species; otherwise I know no other *Saragus* at all resembling it.

#### SARAGUS FRENCHI, n.sp.

Widely oval, convex, glabrous, nitid, black, antennae piceous.

*Head*: epistoma semicircular, narrowly raised on margin, strongly and narrowly raised at antennal orbits, depressed in front of eyes, these larger and not so widely separated as in *S. brunnipennis* MacL.; head and prothorax very minutely punctured, antennae of same length as prothorax, apical joints slightly enlarged and rounded. *Prothorax* ( $2.5 \times 7$  mm.) widest at base where it is more than twice as wide as apex, the latter semicircularly emarginate, anterior angles obtuse, posterior acute, sides rapidly narrowing from base to apex, foliate margins wide and deflexed at base, narrower and convex in front, extreme border very narrow at apex and sides, obsolete at base, base very little sinuate, disc without evidence of central line, with minute punctures more evident on margins than on disc. *Elytra* finely and rather irregularly lineate-punctate, with about 17 lines of fine punctures, both punctures and lines obscure and irregular at centre, more distinct and regular towards the sides, with about

three obscurely marked lævigata intervals, equally placed; other intervals very minutely punctured; foliate margins as wide as those of prothorax at base, very little narrowed till the middle, then rapidly narrowing to apex, extreme edge narrow and reflexed, shoulders round, disc separated by a row of larger punctures. *Abdomen* finely longitudinally strigose, apical segments closely punctured, tibiae hairy, tarsi clothed below with red tomentum. *Dimensions*  $11 \times 8$  mm.

*Hab.*—Eucla, South Australia.

Two specimens, both ♂, are before me; the type from Eucla was kindly sent me by Mr. C. French, the other specimen is amongst the specimens examined by me for the Melbourne Museum, and is labelled "Overland Railway, South Australia." It is evidently very close to *S. Macleayi* Blackb., and less closely allied to *S. brunnipennis* Macl., but distinguished from the former by its greater size, and width and different sculpture. Mr. Blackburn distinguishes his species from *S. brunnipennis* "in having its thorax more strongly sculptured and the interstices of its elytra more or less convex." *S. Frenchi* has its prothorax *much less* strongly sculptured than *S. brunnipennis*, while the interstices of its elytra are not convex, though the lævigata intervals give that appearance in certain aspects. It is easily distinguished from *S. brunnipennis* by its rounder shape, and less pronounced sculpture.

#### AGASTHENES EUCLENSIS, n.sp. (Fig. 2).

Elongate-ovate, above and below jet black, subnitid, apical joints of antennæ and all tarsi piceous, the latter, together with apex of tibiae, with brown tomentose clothing.

*Head* subtrapezoidal; labrum strongly emarginate and rounded, showing membranous hinge; epistoma truncate and raised, with corners obtusely rounded; sides of head raised and rather straightly widened to the antennal orbits; forehead widely convex and separated from epistoma by a wide nonsulcate depression, closely and finely punctulate; antennæ slender, third joint longer than fourth and fifth combined, 4-7 obconic, 8-10 round and wider, eleventh elongate, flattened and ovoid. *Prothorax* transverse

(4 × 5.5 mm.), widest behind middle, apex circularly emarginate, anterior angles acute, strongly produced forward and a little outward, sides widely sinuate anteriorly, more abruptly behind, posterior angles widely acute (about 80°), subdentate and deflexed, base a little trisinate, and, together with the apex, very narrowly bordered; sides with a thick round raised border abruptly ending at both angles; lateral margins foliate (wider than in *A. Goudiei* Carter) with the disc more convex, not perceptibly punctured, having two large depressions in front of basal border. *Scutellum* widely triangular, very convex and glabrous. *Elytra* wider than prothorax at base, parallel for two-thirds of their length, rather flat anteriorly, surface uneven with shallow rugosity, rather closely dotted with large shallow punctures connected by short irregular depressed lines; on each elytron three faintly defined equidistant costæ, obsolete at base and apex; shoulders rounded, sides narrowly horizontal and bordered by narrow raised edge. Abdomen shining, finely longitudinally strigose, the metasternum sulcate in the middle, the prosternum narrowly convex and produced behind, mentum and submentum strongly punctured, the tooth of the latter small, front and intermediate tibiæ slightly curved, all tibiæ with a few scattered reddish hairs and strongly punctulate, anterior tarsi transverse, posterior tarsi with basal joint nearly as long as the rest combined. *Dimensions* 15 × 6 mm.



Fig. 2.

*Hab.*—Eucla, South Australia.

A single specimen, ♂, has been sent by Mr. C. French since my last paper was written. It is nearest to *A. Goudiei* Carter, but differs most markedly in the following characters: (1) size smaller; (2) prothorax with anterior angles less directed outwards, less widely rounded, and deflected, not produced outwards at the posterior angles; (3) elytra more deeply punctured, with more evident costæ. Type in the author's collection.

## AGASTHENES CHAMPIONI, n.sp. (Fig. 3).

Elongate, subparallel smooth, subnitid, oral organs and antennæ reddish.

*Head* more finely and closely punctured than in *A. Westwoodi* Bates, its structural characters otherwise similar; antennæ not quite reaching base of prothorax, third joint at least as long as fourth and fifth combined, cylindrical, 4-10 successively wider and shorter, obconic, eleventh elongate-oval, four apical joints lighter red. *Prothorax* (5 x 7 mm.), length in middle, widest behind middle, base half as wide again as apex, widely emarginate at apex, anterior angles acute (less acute and more outwardly directed than in *A. Westwoodi*), sides widening in a regular curve to beyond half-way, then rather suddenly narrowing and widely sinuate before the acute posterior angle, this produced obliquely outwards and backwards into a blunt tooth-base thinly margined, apex moderately margined at sides only, sides thickly margined; disc minutely and closely punctured (punctures more evident than in *A. Westwoodi*), otherwise smooth. *Scutellum*



Fig. 3.

transverse, triangular. *Elytra* (10.5 x 7 mm.) wider than prothorax at base, shoulders much more squarely rounded, with margins more raised than in *A. Westwoodi*, sides subparallel till near apex, convexity as in *A. Westwoodi*, suture depressed, lateral gutter more defined and wider than in *A. Westwoodi*, with about three obscurely marked depressions, even more minutely punctured than in *A. Westwoodi*, with the lateral row of large punctures continued almost to apex. *Abdomen* faintly strigose, submental teeth bluntly rounded, submentum much less coarsely and more sparsely punctured than in *A. Westwoodi*; other characters very similar to those of Bates' species. *Dimensions* ♂.17 x 7 mm.: ♀.19 x 8 mm.

*Hab.*—Overland railway route E. of Wunbering Rocks, South Australia.

Two specimens occur amongst the Tenebrionidæ examined from the French Collection, Melbourne Museum. This fine species, while nearest to *A. Westwoodi* Bates, can readily be distinguished by its smaller size, more parallel elytra, and the widely different form of the prothorax. The most marked difference lies in the oblique, prominent, posterior angles, with the regular deep sinuation at the sides. In *A. Westwoodi* these angles are wider, less prominent, and meet the incurved sides more abruptly. I have much pleasure in naming it after my friend, Mr. G. C. Champion, to whose courtesy and assistance I am much indebted. Type in National Museum, Melbourne.

Table of described species of *Agathenes*.

- A. Anterior angles of prothorax acute.
  - B. Size large (more than 20 mm. long)..... *Westwoodi* Bates.
  - BB. Size smaller (less than 20 mm. long).
  - C. Prothorax widest near middle.
    - D. Sides of prothorax not sinuate anteriorly..... *Championi* Carter.
    - DD. Sides of prothorax sinuate anteriorly.
    - E. Posterior angles of prothorax deflexed..... *cuclensis* Carter.
    - EE. Posterior angles of prothorax directed outwards.
      - Goudiei* Carter.
  - CC. Prothorax widest near base..... *Frenchi* Carter.
- AA. Anterior angles of prothorax not acute..... *Stephani* Carter.

*ADELIMUM FERGUSONI*, n.sp. (Fig. 4).

Rather widely ovate and flat, dark copper-bronze with a highly polished metallic lustre; oral organs, antennæ, and tarsi reddish; under side metallic black with bluish reflections.

*Head* with labrum very prominent, epistoma evenly rounded, flattish and limited behind by defined circular suture, closely and coarsely punctured, rugose on forehead; eyes transverse and prominent; antennæ extending to base of prothorax, third joint subcylindric and little longer than the fourth, joints 4-10 successively wider, obconic, 8-10 distinctly wider than preceding, eleventh largest, elongate-ovoid. *Prothorax* transverse ( $2 \times 3.1$  mm.), arcuate-emarginate at apex, truncate at base, base and apex about the same width, widest behind middle, moderately

convex, anterior angles distinct and subrectangular, sides strongly rounded, rapidly widening, sinuately contracting before the wide dentate rectangular posterior angles; these a little deflexed; marginal lobes separated by a groove strongly defined anteriorly but not foliaceous (i.e., sculpture of disc continuous to sides), the whole closely and coarsely punctured with finely rugose intervals in places; medial channel distinct throughout, surrounded by a smooth narrow raised border, most evidently raised at the posterior angles. *Scutellum* small, transverse, triangular. *Elytra* considerably wider than prothorax at base and nearly thrice as long, oval with base subtruncate, humeri rather squarely rounded but prominent; punctate-striate, with eight deeply grooved striae on disc and two more on sides; punctures in grooves close and small, scarcely evident towards middle, intervals rather flat in centre of disc, becoming strongly convex laterally, and themselves closely and distinctly punctured. Prosternum, undersides of prothorax, margins and epipleurae strongly punctured, apical segment of abdomen finely punctured, intercoxal process widely rounded, tibiae and basal joints of tarsi clothed beneath with fine yellowish hair. *Dimensions* 10 x 4 mm.



Fig. 4.

*Hab.*—Kuranda, North Queensland.

Two specimens, probably the two sexes, have been generously given to me by Dr. E. W. Ferguson, who captured them. The only sexual difference I can detect, is the slightly longer antennae of the specimen which I take to be the male. It is an aberrant member of Section ii., Subsection D (These Proceedings, 1908, p. 276) in that its elytral intervals are distinctly convex towards the sides, and the elytra are deeply striate; and, moreover, distinguished from all of them by its brilliant metallic colour, and its very pronounced hind angles to prothorax. Type in author's coll.

*Stigmodera pallidipennis* Blackb.—Since writing my notes (These Proc., 1909, p.121), Mr. Blackburn has shown me the type of this species. It is quite distinct from *S. mustelamajor* Thoms. I was misled by assuming the specimens in the Macleay Museum to be correctly named.

*Espites basalis* Pasc.—I have received two specimens of this beautiful insect from Cape York; and have also seen specimens collected by Mr. Hacker, while Mr. Lea has since sent me a specimen for identification, also from the same region. It was described from New Guinea, and has hitherto not been recorded as an Australian species.

*Cardiothorax pygmaeus* Carter.—I found this species fairly common on the hills near Twofold Bay during a short stay in January last. Fresh specimens are darker in general colour than the Macleay Museum types, but this colour is relieved by the raised golden interstices of the elytra near the humeral margins, this gold or coppery sheen decreasing towards the middle of the disc. Larger female specimens are nearly as large as specimens of *C. australis* Carter, but it may be readily distinguished by the more abrupt and distinct dentation of the hind angles of the prothorax.

WEDNESDAY, MAY 25TH, 1910.

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The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, May 25th, 1909.

Mr. C. Hedley, F.L.S., President, in the Chair.

In opening the Meeting, the President made reference to the sorrowful event, whose shadow still lay upon the Empire—the death of His Majesty King Edward VII., which had transpired so unexpectedly in the interval since the last Meeting. Anticipating the wishes of the Members at large, the Council, on behalf of the Society, had already arranged for the transmission of a letter expressive of sincere regret, and of heartfelt sympathy, to His Excellency, Lord Chelmsford, the Governor of the State : and a copy of the letter was read from the Chair. .

Mr. GILBERT WRIGHT, Sydney University, was elected an Ordinary Member of the Society.

The President announced that, under the provisions of Rule xxv., the Council had elected Dr. T. Storie Dixson, Mr. T. Steel, F.L.S., Mr. A. H. S. Lucas, M.A., B.Sc., and Mr. J. R. Garland, M.A., to be VICE-PRESIDENTS; and Mr. J. H. Campbell, [Royal Mint, Macquarie Street] to be HON. TREASURER, for the current Session.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 12 Vols., 52 Parts or Nos., 7 Bulletins, 3 Reports and 16 Pamphlets, received from 46 Societies, &c., and 3 Individuals, were laid upon the table.



## NOTES AND EXHIBITS.

Mr. T. Harvey Johnston exhibited a series of plants showing pathological conditions produced by the presence of minute gall-mites, *Phytoptus* spp. (*Eriophyes* spp.) belonging to the family *Phytoptidae*—(1) pear-leaves showing "blisters" due to the action of *P. pyri* Pag.(Tas.): (2) oranges showing "maori" (*P. oleivorus* Ashm.; coastal districts of New South Wales): (3) tomato "rosette" (*Phytoptus* sp.; Sydney, Bathurst): (4) Crowfoot (*Ranunculus* sp.) showing minute brightly coloured galls along the stem (New South Wales): (5) *Gmelina Leichhardtii*, showing a feltwork on the leaves (Berry; Dr. Cleland): (6) *Banksia marginata*, showing thickening of the bark (Hawkesbury River; Dr. Cleland): (7) Couch-grass (*Cynodon dactylon*) showing "rosette" (Sydney): (8) *Casuarina* sp., showing deformity of small branches (Sydney; Dr. Cleland): (9) *Eucalyptus* sp., showing small brightly coloured galls on petioles and backs of leaves (Pambula, N.S.W.; W. J. Rainbow).

Mr. J. H. Maiden exhibited a "cushion"-plant, locally known as "Yareta," from subalpine Bolivia. It is described as a resinous material used as fuel, and the locality given is "Cerro Alto, altitude 1600 feet," which, it is suggested, may be a mistake for metres. It comes from a correspondent of Mr. G. S. Card, Curator of the Mining and Geological Museum, Sydney. The protective substance is not hair, as in the case of the Vegetable Sheep of New Zealand, but resin. It shows no inflorescence, but is probably a species of *Azorella*, of which three species are recorded from Bolivia. Mr. Maiden also exhibited, for comparison, herbarium specimens of *Bolax glebaria* Comers., (*Azorella caespitosa* Cav.) collected by Dr. (now Sir) J. D. Hooker in the "Erebus" and "Terror" Expedition. He also showed a fine portrait of Robert Brown, litho. by Rud. Hoffmann, 1859, from a contemporary photograph by Maull and Polyblank of London; received from Dr. R. S. Rogers, of Adelaide.

Mr. McDonough exhibited some fine specimens of the fruits of *Endiandra globosa* [N.O. LAURINÆ] from Mullumbimby, N.S.W., somewhat larger than any previously noted.

Mr. Cheel exhibited a series of fungi, remarkable or from unrecorded localities, comprising—**AGARICACEÆ**: *Lentinus cyathus* Berk. and Broome (syn. *L. scleroticola* G. Murray); both the sclerotia and sporophores of this species were collected, among other fungi, by Mr. W. W. Froggatt at Russell Island, Solomon Group, in August, 1909; the only other specimen represented in the National Herbarium collection is a portion of a large slab of sclerotia whittled out by the natives, and brought from Santa Anna Island by Dr. H. B. Guppy, Surgeon, H.M.S. "Lark," in 1883; (for an account of the species, see Murray, Trans. Linn. Soc. Lond. Second Series, Vol. ii. p.229, 1886, Pl. xxxii., figs.1-4); the sclerotium was formerly known as *Pachyma cocos*, and commonly called the Tuckahoe-truffle, or Indian Bread, in North America—**USTILAGINÆ**: *Ustilago utriculosa* Tul.; host, *Polygonum hydropiper* Linn.; Wimburndale Creek, Bathurst(J. H. Maiden and R. H. Cabbage; March, 1910); previously recorded only from Victoria and South Australia on *P. minus* and *P. gracile*. *U. bromivora* Walldh.; host, *Bromus mollis* Linn.; Jindabyne, N.S.W. (Sir J.H. Carruthers; January, 1909); and on *B. arenarius* Labill.; Tammin, W.A.(J. H. Maiden; September, 1909); not previously recorded from West Australia. *Tolyposporium anthistiria* Cobb; host, *Themeda Forskalii* Hæck.(*Anthistiria ciliata* Benth.); Copmanhurst(Rev. — Rupp; November, 1909). Dr. Cobb recorded this from New South Wales without locality (Agric. Gaz. N. S. Wales, iii., 1006, 1892, fig.22)—**BOLETINÆ**: *Boletus hædinus* B. & Br.; Thirroul(E. Cheel; April, 1910); Tuggerah Lakes(S. J. Johnston; April, 1910); previously only recorded from Queensland. *B. lacunosus* Cke. & Mass.; Hill Top(E. Cheel; March, 1910); an edible species previously recorded only from Queensland. *B. granulatus* Linn.; a very common species in pasture-land around Sydney and suburbs, but recorded only from Victoria and Queensland in older works; and from Tingiringi Mountain, N.S.W. (These Proceedings, xxvii., 542, 1902)—**HYMENOGASTRACEÆ**: *Rhizopogon luteolus* Tul.; Penshurst(E. Cheel; June, 1907, and May, 1910; Burwood(Mrs. Walter Friend; August, 1907); Wahroonga(J. Staer; April, 1910); Gladesville and Mos-

man(Miss M. Flockton; May, 1910); the only other previous Australian record is that of Mr. M. C. Cooke, for Victoria(Handb. Aust. Fungi, p.246), the measurements of the spores being stated to be  $7.16 \times 4.6 \mu$ ; in matured specimens from Peshurst, the spores were found to measure from  $5.9 \times 3.3\frac{1}{2} \mu$ ; these were also examined by Mr. T. H. Johnston, of the Bureau of Microbiology, whose measurements were  $7.2 \mu \times 2.7 \mu$ , thus practically agreeing. Mr. G. Massee, in his "Monograph of British Gastromycetes," [Ann. of Bot. iv. 40, 1889] gives the spore-measurements as  $8 \times 3 \mu$ . The "Native Truffle" or "Widida" of the Blacks, mentioned by Mr. Herbert Basedow as having been found at Sandhills, north of Oppariina Spring, South Australia, during the Prospecting Expedition in 1903(vid. Trans. Proc. Roy. Soc. S. Aust., xxviii., p.18, 1904) is very probably identical with this species. It is also mentioned by J. Coghlan, as a delicacy of the Blacks, and found on the western side of the Mulligan(vid. Roth's "North Queensland Ethnography," Bull. No.3).

Dr. Cuthbert Hall exhibited an abnormal seedling of *Eucalyptus Cambagei* and another of *Angophora lanceolata*. The first had normal cotyledons; the first leaves were a normal pair, but the next three leaves were alternate, and following these, then came five whorls of three. One cotyledon of the second had undergone division, giving rise apparently to three cotyledons; the first two pairs of leaves were opposite, sessile, and decussate. A hybrid carnation (*Dianthus caryophyllus*) with three cotyledons, and leaves in whorls of three, was also shown.

Mr. Basset Hull called attention to Mr. F. E. Littler's "Handbook of the Birds of Tasmania and its Dependencies," recently published at Launceston, and issued at a very moderate price, a copy of which was shown; and he expressed the hope that the day when similar Handbooks would be available in the older States was not disappointingly far off.

(Continued on p. 304.)

## REVISION OF AUSTRALIAN TORTRICINA.

BY E. MEYRICK, B.A., F.R.S., CORRESPONDING MEMBER.

In 1881, I published in the Proceedings of this Society two papers, in which I dealt with the *Tortricina* of Australia and New Zealand, so far as then known to me. Excluding the New Zealand species (which are not now given, as I am revising them in a paper in course of publication in the Transactions of the New Zealand Institute), 132 Australian species were there recorded, to which I subsequently added a few more, whilst Mr. Lower has described a good many on various occasions. I am now enabled to record altogether about 434 species, of which about 232 are described as new, so that the progress made has been very considerable, and the character of the fauna can be fairly estimated.

For this excellent result I am greatly indebted to the aid of my Australian correspondents, who on learning that I contemplated this task, sent me a large quantity of most valuable material for examination; I appreciate most highly this generous assistance. Especially I would thank Mr. Geo. Lyell, of Gisborne, who not only sent a completely representative set of all species and varieties in his own extensive collection, but also took pains to get together additional material from his correspondents; the material collected by Miss M. Wise and Messrs. Berthoud, Bleeser, Drake, Findlay, Goudie, Hill, Jarvis, and Trebilcock was forwarded by him. Mr. O. Lower very kindly transmitted the types of all his described species (except two); this was of great importance, as I was thereby enabled to identify them with certainty. Dr. A. J. Turner sent a very useful representative collection of Southern Queensland species. In all, more than twenty collectors have at one time or another

contributed to the following records, acknowledgment being made in each instance; records of locality are attributed to the collector from whom they were first received; the collector's name (added in brackets) must be understood to refer to all those localities in the same State which precede it without the intervention of another collector's name; if no name is given, the observation is my own, except in the case of a few records from the islands, where the collector's name is unknown to me. The South Australian and West Australian species were collected principally during my journeys in 1882 and 1886 respectively.

This paper includes full characters of all families and genera, with partial synonyms of genera (so far as seemed useful to Australian students); a catalogue of all species, with full Australian synonymy; descriptions of all new species, with additional notes or supplementary descriptions in the case of species previously but unsufficiently described; full records of localities; and short recitals of larval habits when recorded, or full particulars if new. Tabulations of the genera are given, but I have not attempted tabulations of the species, because in those genera where they would be most needed, it seemed impossible to make them of practical value; the species are so similar, the colouring so obscure, and the markings often so irregular, indefinite, and variable, that it is impracticable to state distinctions and base categories on a single concise phrase. An attempt to do so in the case of *Capua* and *Tortrix*, for instance, would have been more likely to mislead than to edify. The group is admittedly a difficult one, and there is no easy road to its comprehension; students are advised to study the descriptions closely, and, in the case of nearly related species, to notice particularly the slight structural differences in the secondary sexual characters. Any collector who comes across one of the more local species will do well to devote attention to securing a good series of it, with a view to its proper comprehension. Little has yet been done towards studying the larval habits, and it is much to be desired that collectors should give more time to this, which would well repay them; probably many

of the larvæ feed internally in flower-heads, fruits, stems, or roots.

Owing to the difficulty of the subject, insufficient material, and the bad condition of many of Walker's types in the British Museum, I now find that in my former paper I wrongly identified some of Walker's species. For the purpose of the present paper I carried up my whole material to the British Museum, and made a close comparison with Walker's types, and believe that I have now identified every one of these satisfactorily. The synonymy given in this paper should, therefore, be taken as correcting and superseding that given formerly.

I have also modified my conceptions of certain genera; in particular, I have discarded the presence or absence of a costal fold in the ♂ as a distinctive character, finding that it tended to separate forms otherwise closely related and more naturally placed together, whilst intermediate species occurred in which the fold was in such a rudimentary condition that they might equally well be placed in either class. I consider also that the costal fold and its contained hair-pencil can only be regarded as a particular example of a class of structures which, being intended for sexual recognition and excitement, are essentially specific and not generic in character; and I hold, therefore, that similar tufts and folds occurring in other positions (such as the dorsum of hindwings) are equally unfitted for use as generic distinctions. I do not, however, apply this to other secondary sexual characters, which are not concerned with specific discrimination, such as the structure of the antennæ in the male; the ciliations of these, for example, are evidently necessary to the male and not to the female, and there can be little doubt that by means of them the male apprehends the female, but there is no reason to doubt also that if the male of one species of *Capua* could be equipped with the antennæ of another species, they would serve him equally well, whilst the costal hair-pencil of another species would emit a wrong scent, and would therefore not serve him at all. It will be observed, however, that in some genera, as now limited, the costal fold is as a matter of fact

always present, whilst in many others, even in some of the largest (e.g., *Argyroploce*, of which I am acquainted with about 200 species) it is always absent.

I consider the *Tortricina* to have originated from the *Hilarographa*-group of the *Plutellidae*, and the connecting links are now, in my opinion, pretty well ascertained. The *Chlidanotidae* and *Eucosmidae* started as two collateral lines of development, but the *Chlidanotidae* never came to much. *Laspeyresia* was the earliest form of the *Eucosmidae*, and the *Argyroploce*-group sprang immediately from this. From the *Argyroploce*-group originated the *Peronea*-group of the *Tortricidae*, and the *Carpocossini* are a specialised development of the *Peronea*-group. The *Phalonidae* are an independent offshoot from an early form of the *Tortricidae*.

#### Tabulation of Families.

1. Vein 2 of forewings from beyond $\frac{2}{3}$ of cell.....	2.
Vein 2 of forewings from before $\frac{2}{3}$ of cell.....	3.
2. Hindwings with 5 absent.....	1. CARPOSINIDÆ.
Hindwings with 5 present.....	2. PHALONIADÆ.
3. Hindwings with basal pecten of hairs on lower margin of cell.....	4. EUCOSMIDÆ.
Hindwings without such pecten.....	4.
4. Forewings with 8 and 9 stalked or coincident; hindwings with 5 parallel, 6 and 7 stalked..	5. CHLIDANOTIDÆ.
Forewings with 8 and 9 rarely stalked, and if stalked, then with 5 of hindwings approximated to 4 at base.....	3. TORTRICIDÆ.

#### 1. CARPOSINIDÆ.

Ocelli absent. Forewings with tufts of scales on surface; 2 from posterior fifth to cell, 7 to termen, separate. Hindwings with or without basal pecten on lower margin of cell; 5 absent, 6 usually absent or rudimentary, parallel to 7 when present, 7 to apex.

The elongate wings, tufts of forewings, and peculiar neuration of hindwings make this family easy of recognition. Some of the species are so narrow-winged that even an expert may easily overlook them as not belonging to the *Tortricina*. The larvæ

probably all feed in fruits, shoots, or bark. The main development of the family is in the Australasian region and Pacific islands.

1. Vein 6 of hindwings developed.....	6. <i>SOSINEURA</i> .
Vein 6 of hindwings reduced to a fold or absent.....	2.
2. Second joint of palpi in ♂ with long curled hairs, in ♀ cylindrical with rough scale-projection towards base above.....	5. <i>COSCINOPTYCHA</i> .
Second joint of palpi not so formed.....	3.
3. Hindwings with basal pecten on cell.....	4.
Hindwings without basal pecten on cell.....	5.
4. Forewings with 8 and 9 stalked.....	2. <i>MERIDARCHIN</i> .
Forewings with 8 and 9 separate .....	3. <i>CARPOSINA</i> .
5. Palpi in ♂ subascending, terminal joint moderate; 3 and 4 of hindwings usually separate.....	1. <i>BONDIA</i> .
Palpi in ♂ porrected, terminal joint short, 3 and 4 of hindwings stalked.....	4. <i>PARAMORPHA</i> .

### 1. *BONDIA* Newm.

*Bondia* Newm., Trans. Ent. Soc. Lond.(n.s.) iii., 289

(1856) ... .. type *B. nigella*.

Antennae in ♂ with long fine ciliations (4-5). Palpi in ♂ moderately long, more or less ascending, in ♀ very long, porrected, second joint densely rough-scaled above and beneath, terminal moderate, slender, obtuse, exposed. Forewings: 8 separate. Hindwings without basal pecten on cell; 3 and 4 separate or nearly connate (in *B. digramma* stalked), 6 absent.

All the species are narrow-winged insects of blackish colouring, and frequent the trunks of *Eucalyptus*, being specially assimilated to their appearance when charred by bush fires; which would seem to prove that such fires must be of very ancient occurrence to allow time for the development of a genus of several species wholly adapted to them. The genus is confined to Australia.

### 1. *B. caseata*, n.sp.

♂♀. 17-20 mm. Head, palpi, and thorax blackish, sometimes slightly whitish-sprinkled. Abdomen blackish, anal tuft in ♂ light yellowish. Forewings elongate, narrow, hardly dilated, costa slightly arched, apex round-pointed, termen slightly rounded, very oblique;



dark ashy-fuscon irrorated with black, mixed throughout with golden-leadon-metallic, more brilliant in ♂; a small light ochreous-yellow spot in disc at  $\frac{3}{4}$ : cilia fuscon mixed with black. Hindwings with 3 and 4 separate or almost connate; in ♂ orange-yellow, in ♀ light ochreous-yellow; costa narrowly suffused with dark fuscon; a dark fuscon apical spot extending over about  $\frac{1}{2}$  of wing, in ♂ sometimes very slenderly produced along upper part of termen, in ♀ forming a narrow irregular streak or rather broad fascia variable in extent; subdorsal hairs blackish; cilia dark fuscon.

VICTORIA: Melbourne(Raynor), Gisborne(Lyell)—SOUTH AUSTRALIA: Mount Lofty, Mount Gambier(Guest); from December to March, six specimens. Formerly confused with *B. dissolutana*; the distinguishing characters are noted under that species.

2. *B. dissolutana* Meyr.

(*Bondia dissolutana* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 182.)

The description should be amended in the following particulars:

Forewings in ♂ mixed throughout with bright golden-leadon-metallic. Hindwings in ♂ with apical dark fuscon spot extending over  $\frac{1}{4}$  of wing, produced as a moderate irregular fascia along termen to below middle; in ♀ pale grey, more or less tinged with yellow-whitish in disc, suffused with grey towards apex and along upper part of termen.

NEW SOUTH WALES: Blackheath, 3500 feet, in October. The supposed Melbourne record refers to the preceding species. Differs from *B. cassata* by the absence of yellow discal spot of forewings, the anal tuft of ♂ dark fuscon instead of yellowish, the hindwings in ♀ not yellow, and in ♂ with more extended dark apical patch.

3. *B. attenuatana* Meyr.

(*Bondia attenuatana* Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 183.)

NEW SOUTH WALES: Parramatta, in June and July. This inconspicuous winter species is very probably overlooked by collectors.

*A. B. maleficana* Meyr.

(*Bondia maleficana* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 183.)

QUEENSLAND: Brisbane, in July and August (Turner)—NEW SOUTH WALES: Sydney, Parramatta, from September to November and in March.

*5. B. nigella* Newm.

(*Bondia nigella* Newm., Trans. Ent. Soc. Lond.(n.s.) iii., 289; Meyr., Proc. Linn. Soc. N.S. Wales, 1882, 182.)

QUEENSLAND: Brisbane (Turner)—NEW SOUTH WALES: Glen Innes (3500 feet), Sydney—VICTORIA: Gisborne (Lyll), Mount Alexander, Healesville—TASMANIA: Hobart—SOUTH AUSTRALIA: Mount Lofty, Hoyleton, Mount Gambier (Guest); from May to October.

*6. B. digramma*, n.sp.

♂♀. 13-15 mm. Head, palpi, and thorax dark fuscous, slightly whitish-sprinkled. Abdomen pale grey. Forewings elongate, narrow, hardly dilated, costa slightly arched, apex round-pointed, termen very oblique, slightly rounded; dark shining leaden-grey, sprinkled with blackish; five cloudy irregular transverse blackish streaks, last subterminal, and additional small blackish spots on costa in middle and before apex; a transverse linear whitish mark in disc at  $\frac{2}{3}$ , its upper end right-angled anteriorly and suffused with yellow-ochreous, and a transverse whitish mark rather before it above dorsum; in one ♀ a white transverse line following first blackish streak, some white suffusion in disc before middle, and lower posterior white mark enlarged and connected with upper: cilia grey mixed with black. Hindwings with 3 and 4 stalked; grey-whitish, suffused with grey posteriorly and on lower margin of cell; cilia grey-whitish, suffused with grey round apex and upper half of termen.

WEST AUSTRALIA: Albany, from September to December; five specimens. Differs from all by stalking of veins 3 and 4 of hindwings, and whitish markings of forewings. I regard this as the most ancestral form, and think the genus probably originated in West Australia.

## 2. MERIDARCHIS Zell.

*Meridarchis* Zell., Stett. B. Zeit. 1867, 407(1867). ...

... type *trapeziella*.

*Pezinola* Hamps., Cat. Lep. ii., 79(1890) ... type *longirostris*.

Antennæ in ♂ with long fine ciliations (4-5), basal joint stout. Palpi in ♂ moderately long, in ♀ very long, porrected, second joint with dense projecting scales above and beneath, terminal very short, exposed. Forewings: 8 and 9 stalked. Hindwings with basal pecten on cell; 3 and 4 connate or stalked, 6 absent.

A characteristic Indo-Malayan genus; I am acquainted with about ten species from that region. It is doubtless a development of *Carposina*.

7. *M. zymota*, n.sp.

♂. 16 mm. Head, palpi, and thorax whitish-ochreous irrorated with grey, base and lower longitudinal half of palpi black. Abdomen grey, anal tuft whitish-ochreous. Forewings elongate, rather narrow, posteriorly somewhat dilated, costa hardly arched except towards apex, apex obtuse, termen nearly straight, oblique; whitish-ochreous, irregularly irrorated with fuscous and dark fuscous, somewhat suffused with brownish-ochreous towards costa and on veins; seven more or less elongate marks of blackish irroration on costa; several small ochreous-brownish spots in disc, accompanied by raised tufts; two or three spots of blackish suffusion towards upper angle of cell, and a black dash beneath costa beyond these; some undefined dark fuscous marks round apex and termen: cilia fuscous, irrorated with pale whitish-ochreous. Hindwings rather thinly scaled, grey; cilia grey.

N. GUINEA: Woodlark Island, in April(Mæk); one specimen.

## 3. CARPOSINA HS.

*Carposina* HS., Schm. Eur. v., 38(1855) ... type *berberidella*.

*Enopa* Walk., Cat. xxxv., 1738(1866) ... type *mediella*.

*Oistophora* Meyr., Proc. Linn. Soc. N.S. Wales,  
1881, 699(1881) ... type *mediella*.

*Heterocrossa* Meyr., Proc. Linn. Soc. N.S. Wales,  
1882, 178(1882) ... type *adrepstella*.

Antennæ in ♂ with moderate or long ciliations (1-4). Palpi rather long or very long, longer in ♀, porrected, second joint with projecting scales above and beneath, terminal more or less concealed. Forewings: 8 separate. Hindwings with basal pecten on cell, sometimes in ♂ developed into a large expansible tuft of hairs; 3 and 4 stalked, 6 absent.

The largest genus of the family, with an interesting distribution, the species at present known comprising 2 from Europe, 1 Maderia, 2 North America, 12 Australia, 8 New Zealand, and 33 Hawaiian Islands, indicating an ancient South Pacific (probably Australian) origin; the case is analogous to that of the Pyralid genus *Scoparia*. The few larvæ known feed in fruits and shoots.

#### 8. *C. mediella* Walk.

(*Enopa mediella* Walk., Cat. xxxv., 1738; *Oistophora pterocosmana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 699.)

VIC.: Melbourne (Raynor)—TASM.: Deloraine—S. AUST.: Mount Lofty (Guest)—W. AUST.: Albany; in November and December. My Sydney record is erroneous, and refers to the following species; the distinguishing characters are given below. This and the next species are the only two known to possess the large expansible tuft of hindwings, but some of the others are only known in the female sex. The female does not possess this tuft; otherwise it resembles the male.

#### 9. *C. taractis*, n.sp.

♂♀. 18-19 mm. Head whitish, in ♀ tinged with ochreous. Palpi in ♂ dark fuscous, in ♀ ochreous mixed with dark fuscous, upper hairs white. Antennæ in ♂ shortly ciliated (1). Thorax white, collar and shoulders brown, in ♀ dorsally spotted with brownish. Abdomen whitish-ochreous, segmental margins white. Forewings elongate, narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen almost straight, oblique; whitish, irregularly mixed with ochreous-fuscous, and thinly sprinkled with black; a black dot near base in middle, and a blackish dot beyond it towards dorsum; a small blackish mark

on costa at  $\frac{1}{3}$ , another at  $\frac{1}{3}$ , and five blackish strigulae between this and apex; several small ochreous-fuscous spots accompanied by tufts of scales in disc; a fine blackish terminal line: cilia whitish sprinkled with fuscous, on basal half indistinctly barred. Hindwings in ♂ with expansible scale-tuft not reaching  $\frac{1}{3}$  of wing, thicker and broader than in *C. mediella*; whitish, in ♀ posteriorly greyish-tinged, tuft and dorsal area in ♂ tinged with ochreous; cilia whitish.

N.S.W.: Sydney, in October and April; two specimens. Differs from *C. mediella* by character of tuft of hindwings, which in *C. mediella* extends from base to fully  $\frac{1}{3}$ , and forms a very long dense pecten rather than a broad tuft; also by less oblique termen of forewings, and absence of distinct black dots in disc.

10. *C. nesolocha*, n.sp.

♀. 14-16 mm. Head white. Palpi extremely long, light brownish-ochreous more or less suffused with white above, base and lower longitudinal half dark fuscous. Thorax white, with anterior transverse series of four black dots. Abdomen pale whitish-ochreous. Forewings elongate, narrow, posteriorly hardly dilated, costa gently arched, apex round-pointed, termen straight, very oblique; whitish-ochreous slightly tinged with brownish, with some scattered black scales, becoming yellowish-white towards base and anterior half of costa; a sharp black almost basal dot in middle, one towards dorsum near base, and one beneath costa at  $\frac{1}{3}$ ; two small black strigulae on costa before and in middle; a small blackish spot beneath fold before  $\frac{1}{3}$ , and one above fold beyond  $\frac{1}{3}$ ; a round blackish spot partially edged with whitish above fold before middle, another more distinctly white-edged on upper angle of cell, and a third less marked on lower angle of cell, between these in middle of disc is a transverse grey blotch, and beyond upper angle of cell a small patch of grey suffusion; some light grey irroration towards posterior half of costa and termen; some indistinct blackish dots on termen: cilia grey irrorated with whitish, with two darker lines. Hindwings pale grey; cilia grey-whitish.

W. Aust.: Geraldton, in November; two specimens.

11. *C. autologa*, n.sp.

♀. 22 mm. Head white. Palpi extremely long, fuscous irrorated with dark fuscous, second joint white above. Thorax ochreous-white, with anterior transverse series of four blackish dots. Abdomen pale whitish-ochreous. Forewings elongate, narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen slightly sinuate, very oblique; ochreous-whitish, becoming whitish-ochreous posteriorly, posterior half with a few scattered blackish scales; an ochreous-brown costal streak from base to beyond middle, suffused towards costa with dark grey; a black dot towards dorsum near base; a small blackish spot towards dorsum at  $\frac{1}{3}$ , and a dot above fold beyond it; a small blackish spot in middle above fold, followed by a transverse blotch of grey suffusion; a small blackish spot on upper angle of cell and a dot on lower angle, connected by light brownish-ochreous suffusion; some brownish-ochreous and grey suffusion towards costa posteriorly and termen, and four undefined small blackish-grey spots on posterior half of costa; a cloudy angulated transverse streak of brownish-ochreous and fuscous suffusion about  $\frac{4}{5}$ ; a black line along termen: cilia fuscous irrorated with whitish, with two darker shades. Hindwings whitish-grey; cilia grey-whitish.

W. Aust.: Geraldton, in November; one specimen. Very similar to *C. nasolocha*, but differs by larger size, forewings more dilated posteriorly, termen distinctly sinuate, brown costal streak, black terminal line, and absence of black median dot near base. It is certainly distinct, and though nominally obtained at the same place and time, I took it actually in a different locality from the two examples of the preceding species, which were captured together.

12. *C. mimodes*, n.sp.

♂. 23. mm. Head whitish, crown irrorated with pale fuscous, collar marked with dark fuscous. Antennal ciliations 3. Palpi extremely long, white irrorated with pale fuscous, lower longitudinal half suffused with blackish. Thorax ochreous-whitish,

partially tinged with pale ochreous. Abdomen ochreous-whitish. Forewings elongate, narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen slightly sinuate, rather strongly oblique; light yellow-ochreous, indistinctly streaked between veins with white mixed with fuscous, with a more distinct white subcostal streak from base to middle; costal edge suffused with dark fuscous from base to middle; a black dot in disc at  $\frac{1}{3}$ , another obliquely before it beneath fold, a third before middle above fold, and two at angles of cell; an elongate patch of fuscous irroration mixed with whitish in posterior half of cell; three slight marks of blackish irroration on costa posteriorly, and a row of indistinct minute dots along termen: cilia grey-whitish finely sprinkled with blackish, base ochreous-tinged. Hindwings whitish-grey, paler anteriorly; cilia whitish, round apex greyish-tinged.

W. Aust.: York, in October; one specimen. Superficially much like *C. mediella*, but differs structurally by the much longer antennal ciliations and palpi, and the absence of the expansible tuft of hindwings.

13. *C. telesia*, n.sp.

♀. 20 mm. Head and thorax whitish irrorated with grey. Palpi extremely long, dark grey irrorated with whitish, upper edge whitish. Abdomen ochreous-grey-whitish, with a dark fuscous spot on back at base. Forewings elongate, narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen straight, rather strongly oblique; light brown, irregularly mixed with grey, especially in disc; a small blackish dot near base in middle, and another beyond it near dorsum; a blackish dot in disc at  $\frac{1}{3}$ , and one before it beneath fold, placed in an oblique brownish mark partially outlined with whitish; a small indistinct whitish ring above middle of disc; an indistinct blackish dot below middle of disc; two indistinct blackish dots placed in a brown mark partially edged with whitish traversing end of cell; some slight whitish irroration between veins posteriorly; five indistinct dots of blackish irroration on posterior half of

costa; a terminal series of small dots of black irroration: cilia light fuscous finely sprinkled with whitish. Hindwings pale grey; cilia grey-whitish.

W. Aust.: Albany, in September; one specimen.

14. *C. orphania*, n.sp.

♀. 20 mm. Head and thorax dark fuscous, face irrorated with whitish. Palpi very long, light fuscous irrorated with blackish. Abdomen grey. Forewings elongate, narrow, posteriorly dilated, costa gently arched, apex round-pointed, termen slightly rounded, rather strongly oblique; fuscous suffusedly irrorated with dark fuscous, bases of scales more or less distinctly paler; posterior half of costa with several suffused darker spots followed by pale dots; an elongate blotch of dark suffusion in posterior half of cell, terminated by an obscure pale curved line; usual tufts darker and obscurely pale-edged posteriorly: cilia fuscous mixed with dark fuscous. Hindwings and cilia whitish-fuscous.

S. Aust.: Mount Lofty, in May (Lower); one specimen.

15. *C. petraea*, n.sp.

♂♀. 20-23 mm. Head and thorax whitish, shoulders slightly marked with fuscous. Antennal ciliations in ♂ 1. Palpi very long, longer in ♀, whitish, lower longitudinal half dark fuscous. Abdomen ochreous-whitish, dorsal scales in ♂ modified on median third and slightly ochreous-tinged. Forewings elongate; in ♂ rather narrow, little dilated, in ♀ narrow, moderately dilated posteriorly, costa slightly arched, apex round-pointed, termen almost straight, in ♂ rather strongly oblique, in ♀ very oblique; light fuscous mixed with darker fuscous and whitish, towards anterior half of costa more or less suffused with whitish; six small spots of dark fuscous irroration on posterior  $\frac{2}{3}$  of costa; normal tufts dark fuscous preceded by yellow-ochreous suffusion, viz., one beneath fold near base, one in disc at  $\frac{1}{3}$ , one beneath fold obliquely before it, one beneath middle of disc, and two at angles of cell: cilia whitish irrorated with fuscous and dark fuscous. Hindwings whitish-grey; cilia whitish; in ♂ with a



long whitish hair-pencil from base of dorsum becoming ferruginous-ochreous towards apex.

VIC.: Gisborne (Lyell)—S. AUST.: Mount Lofty (Guest); in November; two specimens.

16. *C. neurophorella* Meyr.

(*Epischnia neurophorella* Meyr., Proc. Linn. Soc. N. S. Wales, 1879, 232.)

Originally based on a single female; I therefore now describe a fine male in Mr. Lyell's collection, the species being little known.

♂. 20 mm. Head and thorax whitish, longitudinally streaked above with dark fuscous. Antennal ciliations 1. Abdomen grey-whitish. Forewings elongate, narrow, posteriorly little dilated, costa gently arched, apex obtuse, termen very obliquely rounded; whitish, partially tinged with yellow-ochreous; all veins marked with well-defined streaks of dark fuscous irroration; blackish raised dots in disc at  $\frac{1}{3}$ , beneath fold before this, below middle of disc, and two more conspicuous black marks on angles of cell: cilia whitish irrorated with dark grey. Hindwings grey-whitish, towards base and dorsum suffused with pale whitish-ochreous, hairs of 1b curled; cilia whitish.

N.S.W.: Sydney—VIC.: Melbourne (Lyell)—S. AUST.: Mount Lofty (Guest); in August, September, and December. Mr. Lyell has taken it "emerging from trunk of *Casuarina*"; I presume the larva fed in the bark; the association with *Casuarina* accounts for the longitudinal striping of the wings, which is frequent in *Lepidoptera* attached to that tree, being adapted to resemble the light and shade effects of the slender twigs.

17. *C. pinarodes*, n.sp.

♂. 23 mm. Head and thorax whitish-ochreous, thorax with some small marks of dark fuscous irroration. Antennal ciliations  $1\frac{1}{2}$ . Palpi extremely long, whitish-ochreous, lower half suffused with dark fuscous except at base. Abdomen ochreous-whitish. Forewings elongate, narrow, posteriorly dilated, costa

gently arched, apex round-pointed, termen almost straight, oblique; whitish-ochreous, irregularly sprinkled with blackish; a small black dot near base in middle, one towards dorsum beyond it, and a larger one beneath costa at  $\frac{1}{3}$ ; a streak of blackish irroration along costa from beyond this to near middle, and six small spots or dots of blackish irroration on costa posteriorly; cloudy dark fuscous dots suffused with brownish-ochreous in disc at  $\frac{1}{3}$ , beneath fold before this, and beneath middle of disc, and irregular spots of blackish irroration between and around these; a brownish-ochreous streak across end of cell, marked at upper extremity with a dark fuscous dot, and preceded by a transverse cloud of blackish irroration, extended irregularly to costa and dorsum at  $\frac{2}{3}$ ; a transverse series of undefined marks of blackish irroration from  $\frac{2}{3}$  of costa to tornus; termen dotted with blackish irroration: cilia pale fuscous, somewhat mixed with dark fuscous and sprinkled with whitish. Hindwings grey-whitish; cilia whitish.

W. Aust.: Albany, in October; one specimen.

18. *C. latebrosa*, n.sp.

♂. 15-16 mm. Head, palpi, thorax, and abdomen pale whitish-ochreous; palpi extremely long, lower longitudinal half suffused with dark fuscous, upper edge whitish; antennal ciliations 1. Forewings elongate, narrow, posteriorly rather dilated, costa gently arched, apex round-pointed, termen almost straight, very oblique; very pale whitish-ochreous, more or less sprinkled with fuscous except towards costa anteriorly; a minute black dot near base in middle, and a larger one beneath costa at  $\frac{1}{3}$ ; six oblique blackish strigulae or dots on posterior  $\frac{2}{3}$  of costa, first sometimes thick; an inconspicuous dark fuscous dot in disc at  $\frac{1}{3}$ , another obliquely before it beneath fold, and one more distinct at upper angle of cell; a series of dark fuscous marks or dots along termen: cilia whitish sprinkled with fuscous. Hindwings with hairs on margin of cell and 1b long and bristly, slightly tinged with ochreous; whitish; cilia whitish.

Tasm.: Deloraine; in December; two specimens.

19. *C. perileuca* Low.

(*Paramorpha perileuca* Low., Trans. Roy. Soc. S. Aust. xxxii. (1908), 116.)

♂♀. 14 mm. Head, thorax, and abdomen white. Antennal ciliations in ♂  $2\frac{1}{2}$ . Palpi in ♂ long, in ♀ very long, white, lower half dark fuscous. Forewings elongate, narrow, posteriorly somewhat dilated, costa slightly arched, apex round-pointed, termen almost straight, rather strongly oblique; white, thinly sprinkled with dark fuscous or blackish; a short black dash beneath costa near base, and a black dot towards dorsum near base; six oblique black marks on posterior  $\frac{2}{3}$  of costa; an oblique dark fuscous mark in disc at  $\frac{1}{2}$ , another beneath fold before this, a somewhat curved sometimes interrupted longitudinal line above middle of disc, and an elongate dot below middle of disc; an angulated subterminal series of undefined spots or marks of dark fuscous irroration; a blackish line along termen: cilia whitish, with two broad fuscous shades. Hindwings and cilia whitish.

N.S.W.: Sydney—VIC.: Gisborne (Lyell), Melbourne, Castle-maine (Lower); always in March. Redescribed from Lower's type (a ♀, not ♂ as stated) and three other specimens.

4. *PARAMORPHA* Meyr.

*Paramorpha* Meyr., Proc. Linn. Soc. N.S. Wales, 1881,

696 ... .. type *aquilina*.

Antennæ in ♂ strongly ciliated ( $2-2\frac{1}{2}$ ). Palpi in both sexes very long, porrected, second joint with rough projecting scales above and beneath, terminal short, exposed. Forewings: 8 separate. Hindwings without basal pecten on cell; 3 and 4 stalked, 6 absent.

Besides the four Australian species, I have six Indo-Malayan. The Australian forms are small whitish insects of similar appearance, and there has been some confusion between them.

20. *P. semotheta*, n.sp.

♂♀. 13-18 mm. Head, palpi, and thorax white, in Sydney form more or less suffused with grey, oblique basal half of palpi

dark fuscous. Abdomen ochreous-whitish. Forewings elongate, narrow, somewhat dilated posteriorly, costa gently arched, apex obtuse, termen slightly rounded, very oblique; white, or in Sydney form grey-whitish, more or less irregularly irrorated with grey and sprinkled with dark fuscous; markings blackish-fuscous; a semioval spot on base of costa, and a subdorsal dot near base; six small spots on posterior  $\frac{3}{4}$  of costa; an inwards-oblique sometimes interrupted linear mark in disc beyond  $\frac{1}{4}$ ; a more or less defined elongate blotch above middle of disc, terminated by two small round spots partly edged with white; a small spot on fold before middle, and one on dorsum at  $\frac{1}{4}$ ; these markings are accompanied by raised tufts, and sometimes edged posteriorly with pale ochreous suffusion; a more or less indistinct irregular subterminal streak of dark suffusion; some very indistinct dark spots on termen: cilia whitish, with two or three cloudy grey shades, sometimes broken into bars. Hindwings and cilia whitish.

N.S.W.: Sydney, in September.—TASM.: Mount Wellington, 3100 feet, in December; seven specimens. Specially characterised by the spot on base of costa.

21. *P. rhachias*, n.sp.

♂♀, 13-14 mm. Head and thorax white. Palpi white, base and lower longitudinal half dark fuscous. Abdomen in ♂ light grey, in ♀ whitish. Forewings elongate, rather narrow, rather dilated posteriorly, costa moderately arched, apex round-pointed, termen almost straight, rather strongly oblique; white, more or less faintly tinged with greyish-ochreous except towards costa anteriorly, with a few fine black specks, veins posteriorly marked with faint greyish-ochreous streaks; a short black strigula on costa beyond  $\frac{1}{4}$ , and five longer oblique black strigulae on posterior half of costa; a dot of ochreous-grey and black irroration accompanied by a tuft of scales beneath fold at  $\frac{1}{4}$ , another above fold at  $\frac{3}{4}$ , a third at lower angle of cell, and a small irregular blackish spot at upper angle of cell; a blackish line or series of marks along termen: cilia fuscous irrorated with whitish, paler towards tornus. Hindwings and cilia whitish-grey.

N.S.W.: Murrurundi, Sydney, in November and April; three specimens. Formerly confused with *P. aquilana*, from which it may be distinguished by the black costal strigula before middle, and the absence of the black discal dot at  $\frac{1}{2}$ .

22. *P. aquilana* Meyr.

(*Paramorpha aquilana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 697.)

N.S.W.: Blackheath, 3500 feet—Vic.: Melbourne, Gisborne (I.yell); in February and March. My Sydney record refers to *P. rhachias*, which is included in the original description; *P. aquilana* has no black strigula on costa before middle, and there is a sharp black dot in disc at or slightly before  $\frac{1}{2}$ ; it is also a narrower-winged insect than *P. rhachias*, and the termen is more oblique.

23. *P. hapalopsis*, n.sp.

♀. 15 mm. Head and thorax grey-whitish. Palpi white irrorated with pale grey, base and lower longitudinal half dark fuscous. Abdomen whitish-ochreous. Forewings elongate, narrow, posteriorly somewhat dilated, costa gently arched, apex acute, termen somewhat sinuate, very oblique; whitish, with scattered black specks, suffusedly irrorated with grey except towards base, becoming darker grey towards costa and posteriorly; a white subcostal streak from base to beyond middle, marked with a black dot near base, and edged beneath by a streak of dark fuscous suffusion except at base; cloudy whitish streaks between veins towards termen; a short line of black scales on termen above middle: cilia grey irrorated with whitish, paler towards tornus, tips mixed with dark fuscous towards middle of termen. Hindwings and cilia whitish.

W. Aust.: Albany, in September; one specimen. Distinct by the acute apex and absence of black dots.

5. *COSCINOPTYCHA* Meyr.

*Coscinoptycha* Meyr., Proc. Linn. Soc. N.S. Wales, 1881,

700 ... .. type *improbana*.

Antennæ in ♂ thickened-dentate, strongly ciliated (3), basal joint swollen. Palpi in ♂ moderately long, subascending, second joint densely rough-scaled beneath and clothed with long curled expansible hairs above, terminal very short, exposed; in ♀ very long, porrected, second joint evenly thickened with dense tolerably appressed scales, towards base above forming an abrupt rough projection, terminal moderate, exposed. Forewings in ♂ with longitudinal membranous bladder-like ridge in disc anteriorly, clothed with flap of dense scales; 8 separate. Hindwings without basal pecten on cell; 3 and 4 connate or short-stalked, 6 absent.

An endemic genus, containing only the single species.

24. *C. improbana* Meyr.

(*Coscinoptycha improbana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 701).

Q.: Brisbane(Turner)—N.S.W.: Sydney; from July to September, in December, January, and April.

6. *SOSINEURA*, n.g.

Antennæ in ♂ strongly ciliated (3), basal joint dilated. Palpi in ♂ moderate, subascending, in ♀ longer, porrected, with appressed scales expanded above towards apex, terminal joint very short, exposed. Forewings in ♂ with deep longitudinal groove in cell anteriorly, causing margins of cell to be approximated towards base; 8 separate. Hindwings in ♂ with large basal patch of modified scales, without basal pecten, in ♀ with basal pecten on cell; 3 and 4 stalked, 6 present, remote, parallel to 7 anteriorly.

Type *S. mimica* Low. This appears to be the most primitive form of the family at present known; the genus is endemic, and contains only one species.

25. *S. mimica* Low.

(*Heterocrassa mimica* Low., Trans. Roy. Soc. S. Austr. 1893, 168.)

N.S.W.: Sydney—VIC.: Melbourne(Kershaw), Gisborne(Lyell)—TASM.: Hobart(Lyell)—S. AUSTR.: Mount Lofty(Guest)—W

Aust.: Albany; from September to April. Lower's description is good and sufficient.

### PHALONIADÆ.

Ocelli usually present. Forewings with 2 from posterior fifth of cell. Hindwings without basal pecten on lower margin of cell; 5 present, 7 to costa.

As thus limited, this family is characteristically European; about 200 species are known from that region, whilst elsewhere it is represented only by a few stragglers. Of the two Australian genera, *Heliocosma*, though endemic and distinct, is a normal exponent of the family; but *Hyperxena* presents dubious features.

#### 7. *HELIOSOMA* Meyr.

*Heliocosmus* Meyr., Proc. Linn. Soc. N. S. Wales, 1881,

653      ...      ...      ...      ...      ... type *incongrua*.

Antennæ in ♂ broadly compressed and flattened. Palpi very long, porrected, second joint with rough projecting scales diminishing anteriorly, terminal moderately long, exposed. Thorax without crest. Forewings with scale-tufts on surface, 7 to termen, 8 separate. Hindwings with 3 and 4 remote, 5 parallel, 6 and 7 remote, nearly parallel.

At present only known from the Australian region; though similar to European forms, it differs from them all by the parallel veins 6 and 7 of hindwings, which are closely approximated or stalked in all European genera.

#### 26. *H. anthodes*, n.sp.

♂♀. 17-18 mm. Head and thorax in ♂ whitish-ochreous, tinged with crimson on face and shoulders, in ♀ yellower and more largely suffused with light crimson. Palpi crimson-whitish or light crimson, becoming fuscous towards apex, whitish towards base. Abdomen pale whitish-ochreous, in ♀ tinged with grey. Forewings elongate, narrow towards base, dilated posteriorly, costa slightly arched, more strongly posteriorly, apex round-pointed, termen sinuate, oblique; ochreous-whitish; a pale crimson

streak along costa from base to  $\frac{2}{3}$ , in ♀ broader and more suffused; a white streak running from beneath apex of this almost to dorsum beyond middle, whole anterior area of wing yellow-ochreous, becoming deeper and brownish-tinged just before the white streak; in ♂ undefined patches of pale whitish-rosy suffusion before and beyond tornus and on costa before apex, post-tornal patch edged above and costal beneath by marks of yellow-ochreous suffusion, and some yellowish suffusion in disc before these; in ♀ the whole posterior area is suffused with light crimson, except white wedge-shaped marks resting on termen below apex and below middle: cilia in ♂ whitish partially tinged with pale rosy, in ♀ wholly pale crimson. Hindwings in ♂ whitish-grey, in ♀ grey; cilia grey-whitish.

W. AUST.: York, in October; two specimens.

27. *H. rhodopnoana* Meyr.

(*Helioeosma rhodopnoana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 694.)

The ♂ (not hitherto described) is similar to the ♀, but varies considerably in the development of the crimson colouring, the groundcolour varying from ochreous with a faint rosy tinge to rose-pink, but not so deep or bright as in ♀.

VIC.: Melbourne(Raynor), Gisborne(Lyell)—TASM.: George's Bay—S. AUST.: Mount Lofty(Guest)—W. AUST.: Perth, Albany; from November to January.

28. *H. incongruana* Walk.

(*Conchylis incongruana* Walk., Cat. xxviii., 363; *Eromens apertella* ib. xxxv., 1762; *Helioeosma incongruana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 695.)

Q.: Duaringa (Barnard), Warwick, Stradbroke I. (Turner)—N.S.W.: Tenterfield (Turner), Blackheath (3500 feet), Sydney—VIC.: Gisborne, Beaconsfield(Lyell), Wandin(Jarvis), Melbourne—TASM.: Deloraine, George's Bay, Hobart—S. AUST.: Mount Lofty(Guest); from September to April. Larva in a portable case on flowers of *Lysinama pungens* and *Epacris* in August (and doubtless later).



29. *H. exæca*, n.sp.

♂♀. 12-13 mm. Head and thorax white. Palpi white, tinged externally with ochreous. Abdomen whitish. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen obliquely rounded; white, partially tinged with pale ochreous-yellowish; basal fifth of costa suffused with ochreous; a more or less developed outwardly oblique ochreous streak from dorsum near base, reaching half across wing; a deep ochreous narrow fascia slightly beyond middle parallel to termen, tending to be obsolete at extremities, posteriorly edged with a few black specks; an irregular narrow ochreous fascia just before termen from apex to tornus, anteriorly edged with a few black specks; between this and preceding fascia is sometimes more or less irregular pale yellow-ochreous suffusion: cilia white, partially tinged with yellow-ochreous, with a few black specks, especially at tornus. Hindwings and cilia whitish.

NEW GUINEA: Sudest I. (Meek)—Q.: Townsville, in May (Dodd); three specimens. The smallest, relatively shortest-winged, and least decorative species.

8. *HYPERXENA* Meyr.

*Hyperxena* Meyr., Proc. Linn. Soc. N. S. Wales, 1882,

177 ... .. type *scierana*.

Palpi very long, porrected, second joint with long rough obliquely projecting scales above, terminal long, rough-scaled above. Thorax with double posterior crest. Forewings with tufts of scales, 7 to costa, 8 separate. Hindwings with 3 and 4 remote, parallel, 5 nearly parallel, 6 to costa, 6 and 7 remote, nearly parallel.

The single species, of which the ♂ is still unknown, is superficially dissimilar to the rest of the family, and its structural characters are so far unspecialised as to leave its affinity somewhat uncertain; but after a very careful consideration of the two original specimens, which are all I have seen, I can see no grounds for referring them elsewhere, and think they may be a primitive type of this group.

30. *H. scierana* Meyr.

(*Hyperxena scierana* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 177.)

N.S.W.: Blackheath (3500 feet), Parramatta; in August and September. Probably overlooked by collectors through its early appearance; should be looked for at Sydney in July.

## TORTRICIDÆ.

Ocelli present. Forewings with 2 from before  $\frac{3}{4}$  of cell. Hindwings without basal pecten on lower margin of cell.

This extensive family contains the majority of the Australian *Tortricina*, and the same case holds in New Zealand, whilst in other regions the *Eucosmidæ* are the dominant family. The forty Australian genera fall roughly into three groups, which are natural, though not capable of strict definition; viz. (a) the primitive *Peronæa*-group, in which the forewings have tufts of scales on the surface, and the neuration is variable and unspecialised (genera 37-48); (b) the typical *Tortrix*-group (genera 25-36); and (c) the *Capua*-group, in which veins 7 and 8 of forewings are stalked (genera 9-24). This last group, though occurring also in other regions, is much more extensively developed in Australia than elsewhere; whilst the first group is less developed than elsewhere, and probably mainly indicative of comparatively recent Malayan immigration.

- |  |                  |
|--|------------------|
| 1. Head smooth-scaled.....                                     | 2.               |
| Head not smooth-scaled.....                                    | 4.               |
| 2. Forewings with 3 from angle.....                            | 3.               |
| Forewings with 3 from considerably before angle...             | 26. CHRISMARCHA. |
| 3. Hindwings with 3 and 4 connate, 6 and 7 stalked.            | 27. ZACORISCA.   |
| Hindwings with 3 and 4 approximated, 6 and 7 approximated..... | 28. ATTERIA.     |
| 4. Forewings with 7 absent (coincident with 8).....            | 21. ATELODORA.   |
| Forewings with 7 present.....                                  | 5.               |
| 5. Forewings with 7 and 8 stalked.....                         | 6.               |
| Forewings with 7 separate.....                                 | 22.              |
| 6. Forewings with 7 to costa ..                                | 39. DICHLOPA.    |
| Forewings with 7 to termen...                                  | 7.               |

7. Forewings with 9 out of 7.....	40. DRACHMOBOLA.
Forewings with 9 separate.....	8.
8. Forewings with 3 and 4 stalked.....	41. TYMBARCHA.
Forewings with 3 and 4 separate.....	9.
9. Hindwings with 4 absent.....	18. LAMYBODES.
Hindwings with 4 present.....	10.
10. Hindwings with 3 and 4 separate.....	11.
Hindwings with 3 and 4 connate or stalked.....	17.
11. Forewings with 3 from considerably before angle..	12.
Forewings with 3 from angle.....	13.
12. Thorax with crest.....	20. ARISTOCOSMA.
Thorax without crest.....	23. ADOXOPHYES.
13. Hindwings with 3 and 4 remote.....	14.
Hindwings with 3 and 4 nearly approximated at base.....	22. PROCALYPTIS.
14. Hindwings with 3, 4, 5 equidistant.....	15.
Hindwings with 4 nearer 5 at base than 3.....	16.
15. Palpi subascending, thoracic crest large.....	12. PYRGOTIS.
Palpi porrected, thoracic crest small or absent....	11. ISOCHORISTA.
16. Thorax with crest.....	13. ACROPOLITIS.
Thorax without crest.....	10. PARASKLENA.
17. Palpi ascending.....	18.
Palpi porrected.....	19.
18. Thorax with crest.....	14. ANTHENOPTYCHA.
Thorax without crest.....	24. HOMONA.
19. Antennæ with basal third thickened with dense scales.....	15. RHOMBOCEROS.
Antennæ with basal third not thickened.....	20.
20. Palpi in ♂ with large expansible fringe of hairs above.....	16. ACROCEUTHES.
Palpi in ♂ without such fringe.....	21.
21. Palpi in ♂ cylindrical, with appressed scales except near base.....	17. AROLOMONTOMA.
Palpi with projecting scales above and beneath....	19. CAPUA.
22. Forewings with 8 and 9 stalked.....	23.
Forewings with 8 and 9 separate.....	24.
23. Thorax with crest.....	48. MICTONEURA.
Thorax without crest.....	44. PARASTRANGA.
24. Forewings with 7 to costa.....	46. PERONIA.
Forewings with 7 to apex or termen.....	25.
25. Forewings with 3 and 4 stalked.....	26.
Forewings with 3 and 4 separate.....	27.
26. Hindwings with 4 absent.....	45. EBODA.
Hindwings with 4 present.....	42. SPATALISTIS.

27. Hindwings with 7 from cell considerably before angle.....	43. SCOLIOFLECTA.
Hindwings with 7 from angle.....	28.
29. Hindwings with cell open between 4 and 6....	37. DIACTENIS.
Hindwings with cell closed.....	29.
29. Hindwings with 3 and 4 separate.....	30.
Hindwings with 3 and 4 connate.....	34.
30. Hindwings with 3 and 4 widely remote .....	31.
Hindwings with 3 and 4 approximated at base....	32.
31. Forewings with tufts of scales.. ..	47. PALÆOTOMA.
Forewings without tufts.....	9. PROSELENA.
32. Thorax with crest.....	34. HARMOLOGA.
Thorax without crest.....	33.
33. Palpi ascending.....	30. MERITASTIS.
Palpi porrected.....	31. EPICHOEISTA.
34. Palpi ascending .....	25. CACOEZIA.
Palpi porrected.....	35.
35. Terminal joint of palpi absent.....	36. XENOTHICTIS.
Terminal joint of palpi present.....	36.
36. Hindwings with 6 and 7 stalked.....	35. CNEPHASIA.
Hindwings with 6 and 7 approximated.....	37.
37. Forewings with tufts of scales .. ..	38. ARGYROTOXA.
Forewings without tufts.....	38.
38. Antennæ in ♂ dentate, fasciculate-ciliated, palpi long or very long.....	32. AROTROPHORA.
Antennæ in ♂ simply ciliated, palpi moderately long.....	39.
39. Thorax with crest.....	33. EULIA.
Thorax without crest.....	29. TOETRIX.

### 9. PROSELENA Meyr.

*Proselena* Meyr., Proc. Linn. Soc. N. S. Wales,  
1881, 421 ... .. type *annosana*.  
*Prothelymna* Meyr., Trans. N. Z. Inst., 1882, 57, type, *antiquana*.

Antennæ in ♂ rather strongly ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal short. Thorax smooth. Forewings with 7 to termen, 8 separate. Hindwings with 3 from much before angle, remote and nearly equidistant from 2 and 4, 4 from angle, 5 rather approximated to 4 at base, transverse vein extremely oblique, 6 and 7 long-stalked.

Originally founded on a single species; I subsequently widened the generic characters so as to include some other forms which I now believe to have no immediate affinity here, and have therefore removed them to a new genus in the neighbourhood of *Tortrix*. There is now only one Australian species, which is undoubtedly closely allied to the following genus, *Parasolena*, and must be supposed to have arisen from it by the reduction and disappearance of the stalk of veins 7 and 8 of forewings; and two New Zealand species, curious forms which are not much like the type or one another, but appear to agree in all essential structure.

31. *P. annosana* Meyr.

(*Proselena annosana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 421.)

N.S.W.: Parramatta—TASM.: Launceston—S. AUST.: Wirrara; from September to November.

10. *PARASOLENA*, n.g.

Antennæ in ♂ moderately ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal short. Thorax smooth. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 from much before angle, remote and nearly equidistant from 2 and 4, 4 from angle, 5 rather approximated to 4 at base, transverse vein very oblique, 6 and 7 long-stalked.

Type *P. thannas* Meyr. The species are similar in general characters to the preceding, from which they differ only by the stalking of veins 7 and 8 of forewings. The genus is endemic, and must be regarded as a modification of *Isochorista*.

32. *P. tenella*, n.sp.

♀. 8 mm. Head and palpi whitish. Thorax whitish, partially tinged with pale yellow-ochreous. Abdomen pale whitish-ochreous. Forewings elongate, costa moderately arched, apex round-pointed, termen rounded, rather strongly oblique; white, thinly sprinkled with fuscous; an undefined basal patch and

moderately broad fasciæ at  $\frac{1}{2}$  and  $\frac{3}{4}$  formed by irregular yellow-ochreous suffusion: cilia whitish, with a few fuscous specks. Hindwings and cilia white.

N.S.W.: Bathurst, 2500 feet, in November; one specimen.

### 33. *P. thamnas*, n.sp.

♂. 12 mm. Head whitish, tinged with fuscous on crown except in middle. Palpi whitish, sprinkled with grey externally. Antennal ciliations 2. Thorax whitish-fuscous sprinkled with dark fuscous. Abdomen whitish-ochreous. Forewings elongate, costa moderately arched, apex round-pointed, termen rounded, rather strongly oblique; light fuscous mixed with whitish; some undefined spots of yellow-ochreous suffusion arranged as though indicating a basal patch and narrow transverse fasciæ at  $\frac{1}{2}$  and  $\frac{3}{4}$ : cilia grey-whitish, with a few fuscous specks. Hindwings and cilia whitish-grey.

S. Austr.: Adelaide, in October; two specimens.

## 11. ISOCHORISTA Meyr.

*Isochorista* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 424 ... .. type *ranulana*.

Antennæ in ♂ shortly or moderately ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal short. Thorax usually with slight crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 2 widely remote from 3, 3-5 moderately remote, equidistant and nearly parallel, transverse vein oblique, 6 and 7 long-stalked.

An endemic genus, probably derived from *Capua*, to which the species are generally similar. They are frequently small and obscure insects, but locally abundant where they occur. None are yet known in the larval stage.

### 34. *I. cerophanes*, n.sp.

♂. 13 mm. Head, palpi, and thorax light ochreous-yellowish. Abdomen light grey. Forewings elongate, suboblong, without costal fold, costa moderately arched towards base, thence nearly

straight to near apex, apex obtuse, termen obliquely rounded; whitish-ochreous, with a few scattered dark fuscous scales; about 10-11 little oblique rather irregular ochreous-yellow transverse striae, partially coalescing to form a basal patch and central fascia; some dark fuscous strigulation towards dorsum before and beyond central fascia; some scattered dark fuscous strigulae on costa; costal edge of central fascia suffused with dark fuscous, and two small dark fuscous spots with some grey suffusion on costa towards apex: cilia light ochreous-yellowish. Hindwings and cilia fuscous.

Q.: Eumundi; amongst subtropical scrub, in November(Turner); two specimens. Differs from all by its general ochreous-yellowish colouring.

35. *I. melanocrypta*, n.sp.

♂. 11-12 mm. Head, palpi, thorax, and abdomen bronzy-fuscous; antennal ciliations minute. Forewings elongate, without costal fold, costa moderately arched, apex obtuse, termen slightly rounded, oblique; rather light purplish-grey; markings formed of mixed ferruginous and black scales; a moderate basal patch, outer edge angulated in middle; a stria near beyond this; central fascia reduced to a costal spot not reaching half across wing, connected by a stria with dorsum; an irregular stria beyond this, costa somewhat marked with white about its origin; two or three irregular striae before termen, coalescing on posterior fourth of costa into a triangular patch: cilia whitish-ochreous, basal half spotted with dark grey. Hindwings grey; cilia whitish-grey, with grey subbasal shade. Undersurface of forewings suffused with dark purplish-fuscous except towards dorsum and termen; undersurface of hindwings with streaks of dark purple-fuscous suffusion along dorsum and anterior half of costa.

Q.: Mount Tambourine, in October(Turner); two specimens. An obscure insect, but specially characterized by the dark suffusion of undersurface, which is, however, not improbably a sexual character.

36. *I. encotodes*, n.sp.

♂♀. 14-15 mm. Head and thorax brownish mixed with dark fuscous. Palpi dark fuscous, with a few whitish scales. Antennae

ciliations in ♂ 1. Abdomen dark grey. Forewings elongate, moderate, costa gently arched, in ♂ without fold, apex obtuse, termen slightly rounded, oblique; fuscous, with a faint purplish tinge; about 9-10 coarse oblique strise of black irroration more or less mixed with deep ferruginous; in the ♂ example there is some irregular whitish irroration between these, especially in the space between basal patch and central fascia, and towards costa beyond central fascia: cilia fuscous mixed with paler, with a blackish antemedian line. Hindwings rather dark fuscous; cilia fuscous, with a darker subbasal shade.

TASM.: Mount Wellington, 1200 feet, in December; two specimens. This and the next species are best distinguished from the other similar obscure species which follow, by the absence of costal fold in ♂.

37. *I. pumicosa*, n.sp.

♂. 12 mm. Head and thorax ashy-fuscous. Palpi dark fuscous, with some whitish scales. Antennal ciliations  $\frac{1}{2}$ . Abdomen dark grey. Forewings elongate, costa without fold, gently arched, apex obtuse, termen almost straight, oblique; ashy-fuscous; about ten coarse irregular oblique strise of black irroration somewhat mixed with ferruginous scales, on costal edge separated by whitish scales: cilia fuscous with a dark fuscous antemedian shade, base whitish. Hindwings rather dark fuscous, darker posteriorly; cilia fuscous, with dark fuscous subbasal shade.

VIC.: Mount St. Bernard, 5000 feet, in February (Lyell); type in Coll. Lyell. Differs from *I. encotodes* by much shorter ciliations of antennae in ♂, therefore certainly distinct; smaller and darker, with much less ferruginous admixture, and central fascia not obviously defined.

38. *I. parmiferana* Meyr.

(*Capua parmiferana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 534.)

N.S.W.: Woodford (Lyell), Sydney; in October and March.



39. *I. ranulana* Meyr.

(*Isochorista ranulana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 424).

Q.: Brisbane(Turner), Toowoomba—N S.W.: Glen Innes(3500 feet), Murrarundi, Bathurst, Mittagong, Sydney, Bulli—Vic.: Beaconsfield(Lyell), Healesville, Sale—S. AUST.: Mount Lofty, Wirrabarra; from August to December, and in March and April. The smallest species of the genus.

40. *I. helota*, n.sp.

♂. 9-10 mm. Head, palpi, and thorax brownish, sometimes mixed with blackish, base and extreme apex of palpi whitish. Abdomen dark grey. Forewings elongate, costa gently arched, with fold reaching to near  $\frac{2}{3}$ , apex obtuse, termen slightly rounded, oblique; fuscous, with a faint purplish tinge; about 8-10 irregular broken oblique transverse striæ of blackish irroration largely suffused with bronzy-yellowish or bronzy-ochreous, on costa sometimes edged with whitish: cilia whitish-yellowish partially suffused with grey, with two blackish lines. Hindwings dark fuscous, with slight bronzy tinge; cilia grey, with darker subbasal shade.

VIC.: Healesville—TASM.: Deloraine; in November and December, ten specimens. Smaller than any other species except *I. ranulana*, which is narrower-winged and much more distinctly marked.

41. *I. panæolana* Meyr.

(*Isochorista panæolana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 425.)

N.S.W.: Blackheath (3500 feet)—VIC.: Gisborne, Mount Macedon, Beaconsfield (Lyell)—TASM.: Mount Wellington—S. AUST.: Mount Lofty, Mount Gambier(Guest); from September to December. Mr. Lyell writes "in swarms on grassy hillsides in spring."

42. *I. chaodes*, n.sp.

♂♀. 12-14 mm. Head, palpi, and thorax fuscous, sometimes with a few ochreous scales. Abdomen bronzy-fuscous. Fore-

wings elongate, posteriorly dilated, costa slightly arched, with fold reaching to beyond middle, apex obtuse, termen almost straight, oblique; fuscous, with a slight purplish tinge, with very undefined irregular oblique striae of black irroration more or less interspersed with reddish-ferruginous and yellow-whitish scales; often a large triangular whitish dorsal blotch somewhat before middle, reaching more than half across wing, but this is sometimes indistinct or absent; sometimes more or less whitish suffusion between striae towards tornus and termen: cilia fuscous, more or less distinctly barred with pale ochreous, with a line of black irroration. Hindwings rather dark fuscous, slightly brassy-tinged; cilia light fuscous or whitish-fuscous, with darker subbasal shade.

TASM.: Hobart—VIC.: Mount Macedon(Lyell); in December, ten specimens.

43. *I. acrodesma* Low.

(*Capua acrodesma* Low., Trans. Roy. Soc. S. Austr., 1902, 234.)

♂. 12-15 mm. Antennal ciliations  $\frac{1}{2}$ . Forewings elongate, costa slightly arched, bent towards middle, fold reaching to beyond  $\frac{2}{3}$ , apex obtuse, termen straight, oblique; light ashy-grey mixed with whitish; about ten irregular oblique striae of mixed black and ochreous scales: cilia light grey barred with whitish, with an interrupted black subbasal line. Hindwings grey; cilia grey, paler towards tips.

N.S.W.: Broken Hill(Lower)—VIC.: Wandin, Gisborne(Lyell); in September and October. Shortly redescribed from type and four other examples.

44. *I. callizyga* Low.

(*Pyrgotis callizyga* Low., Trans. Roy. Soc. S. Austr. 1901, 69.)

Groundcolour of forewings varies from pale ochreous-yellowish to ochreous-white. Characterised by well-defined dark fuscous markings, extension of basal patch along dorsum, and tornal blotch connected with central fascia.

VIC.: Gisborne(Lyell)—S. AUST.: Mount Lofty, Mount Gambier(Guest); in October and November. Three specimens seen, all ♀.

45. *I. cosmota* Meyr.

(*Isochorista cosmota* Meyr., Proc. Linn. Soc. N.S. Wales, 1886, 1038; *Acropolitis heliochares* Low., Proc. Linn. Soc. N. S. Wales, 1898, 47.)

Forewings with costal fold reaching to beyond middle; a subcostal flap of projecting scales from near base to near middle; an expansible triangular projection of scales from dorsum towards base. Hindwings beneath with a strong upcurved longitudinal ridge traversing upper part of cell, causing partial distortion of wing; 5 unusually remote from 4.

VIC.: Gisborne(Lyell)—S. AUST.: Mount Lofty(Guest), Blackwood(Lower); in November and December. Very distinct by the yellow colouring, with dark fuscous costal streak and posterior band; I give fully the peculiar sexual characters above; only three ♂ specimens seen.

12. *Pyrgotis* Meyr. -

*Pyrgotis* Meyr., Proc. Linn. Soc. N. S. Wales, 1881,

439 ... .. type *insignana*.

Antennæ in ♂ moderately strongly ciliated. Palpi moderate, subascending, second joint with rough projecting scales beneath and towards apex above, terminal moderate. Thorax with large double crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3-5 separate, equidistant, rather approximated towards base, 6 and 7 short-stalked.

Besides the following, I now include only two New Zealand species in this genus. Prof. Fernald endeavours to make *P. plagiatana* Walk., the type, but it does not agree with the structural characters as defined.

46. *P. insignana* Meyr.

(*Pyrgotis insignana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 440.)

Q.: Brisbane—N.S.W.: Blackheath, 3500 feet—VIC.: Gisborne (Lyell), Melbourne—TASM.: Deloraine—S. AUST.: Mount Gambier (Guest), Mount Lofty—W. AUST.: Waroona (Berthoud), Albany; from September to December, and in March.

### 13. ACROPOLITIS Meyr.

*Acropolitis* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 432 ... .. type *magnana*.

*Thrincoophora* Meyr., Proc. Linn. Soc. N.S. Wales,

1881, 431 ... .. type *impletana*.

Antennæ in ♂ moderately ciliated. Palpi moderate, porrected, second joint more or less dilated with projecting scales above and beneath, terminal short. Thorax with double posterior crest. Forewings with ridges of slightly raised scales, 7 and 8 stalked, 7 to termen. Hindwings with 3 from rather before angle, more or less separate from 4, 5 closely approximated or connate with 4, 6 and 7 closely approximated at base or short-stalked.

Confined to Australia; it is not improbable that all the species are attached to various forms of *Acacia*. The genus is easy of recognition; but the species, though all of rather large size, are difficult and puzzling, and require very close attention. When writing my former paper, I was unfortunately not sufficiently alive to this difficulty, and therefore identified some of Walker's species wrongly; but I think the synonymy as now given after careful examination of his types will be found correct.

### 47. *A. dryinodes*, n.sp.

♂ 25.26 mm., ♀ 30.36 mm. Head, palpi, and thorax dark ashy-fuscon. Abdomen fuscon. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, in ♂ with fold reaching  $\frac{1}{3}$ , apex obtuse, termen almost straight, nearly vertical; dark ashy-fuscon, bases of scales more or less whitish, strewn with scattered black strigulae, sometimes with some ferruginous-brownish scales especially in disc above middle and on veins; markings obscure and undefined, formed by darker suffusion, viz., a small basal patch with outer edge angulated, an irregular very

oblique central fascia, contracted above middle, broader on lower portion and tending to coalesce with an elongate-triangular blotch extending along posterior  $\frac{2}{3}$  of costa, and a transverse patch resting on termen above tornus; sometimes a slender black longitudinal dash crossing middle of central fascia, above which in ♀ is sometimes more or less undefined ochreous-brownish suffusion: cilia grey with a blackish line. Hindwings with 6 and 7 usually approximated; fuscous, strigulated with darker, towards apex suffused with darker; cilia grey, with darker subbasal shade, sometimes becoming whitish towards dorsum.

N.S.W.: Blackheath, 3500 feet (Turner)—VIC.: Gisborne (Lyell); in March and April, fifteen specimens. Bred in plenty from spun leaves (phyllodia?) of *Acacia melanoxylon* by Mr. Lyell, who sent me a fine series, showing the constancy of the specific characters. The Blackheath specimens seen are only females, a large and fine form, but apparently not distinguishable.

#### 48. *A. dolosana* Walk.

(*Tortrix dolosana* Walk., Cat. xxviii., 331; *Acropolitis dolosana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 435.)

♂ 20-25 mm., ♀ 24-30 mm. Forewings with costal fold in ♂ reaching somewhat beyond  $\frac{1}{2}$ , termen in ♂ almost straight, in ♀ slightly sinuate, hardly oblique, rounded beneath; leaden-grey, very obscurely strigulated with ferruginous-ochreous, with dark ashy-fuscous markings sprinkled with black. Hindwings with 6 and 7 stalked, fuscous with distinct (sometimes strong) fulvous tinge, strigulated with darker fuscous. Recognisable by the dark colouring and suffused markings.

VIC.: Gisborne (Lyell), Melbourne (Raynor)—TASM.: Deloraine—S. AUST.: Mount Lofty, Balaklava (Guest); from September to December.

#### 49. *A. excelsa*, n.sp.

♂. 24 mm. Head, palpi, and thorax grey. Abdomen pale grey. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, with fold reaching to beyond  $\frac{1}{3}$ , rather

broad, apex obtuse, termen straight, vertical, rounded beneath; grey, somewhat sprinkled with ferruginous and whitish, and strewn with blackish strigulae; markings formed by dark grey suffusion, viz., a basal patch with outer edge angulated, a central fascia moderate towards costa, dilated and more mixed with black in disc, becoming obsolete towards dorsum, a costal patch confluent with this anteriorly and gradually diminishing to apex, a transverse blotch from termen above tornus, and a spot along upper half of termen: cilia pale grey mixed with darker (imperfect). Hindwings with 6 and 7 stalked; light grey; a yellowish. white costal patch extending from  $\frac{1}{3}$  to  $\frac{2}{3}$ ; cilia whitish, round apex suffused with grey, with a grey subbasal line.

Vic.: Mount St. Bernard, 5000 feet, in February (Lyell); type in Coll. Lyell. Most like *A. signigerana*, but certainly distinct by different costal fold, and costal patch suffused into central fascia.

50. *A. malocodes*, n.sp.

♀. 28 mm. Head, palpi, and thorax white, finely sprinkled with yellowish-grey. Abdomen whitish. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, apex obtuse, termen nearly straight, little oblique, rounded beneath; white, partially very faintly tinged with ochreous; markings faint, formed by a fine grey sprinkling, here and there slightly marked with yellowish; an angulated stria indicating edge of basal patch; central fascia narrow on upper half, interrupted above middle, broad and irregular on lower half; five small spots on posterior half of costa, last three included in a triangular suffused patch; a narrow patch along lower  $\frac{2}{3}$  of termen, sending a triangular projection towards middle of disc: cilia white, with an interrupted grey line. Hindwings with 6 and 7 stalked; whitish-grey; cilia white.

W. Aust.: Albany, in December; one specimen. Distinct by the white groundcolour and faint markings.

51. *A. magnana* Walk.

(*Portrix magnana* Walk., Cat. xxviii., 330; *Acropolitis magnana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 434.)

Forewings broader than in other species except *A. passalotana*, termen vertical, in ♂ almost straight, in ♀ slightly sinuate; costal patch connected with termen above tornus by a moderate fascia, preceded and followed by distinct white suffusion. Hindwings with 6 and 7 stalked, distinctly tinged with yellowish throughout.

N.S.W.: Sydney, Newcastle; in October.

52. *A. canana* Walk.

(*Tortrix canana* Walk., Cat. xxviii., 331; *Acropolitis canana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 433.)

Q.: Brisbane. Walker's type is a ♀; it is still unique.

53. *A. impletana* Walk.

(*Tortrix impletana* Walk., Cat. xxviii., 331; *Thrinophora impletana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 431.)

♀. 27 mm. Head, palpi, and thorax fuscous mixed with dark fuscous and whitish. Abdomen light fuscous. Forewings sub-oblong, costa anteriorly moderately arched, posteriorly straight, apex obtuse, termen somewhat rounded, little oblique; fuscous or grey mixed with whitish and a few ferruginous-brown scales, and strewn with dark fuscous or blackish strigulae; basal patch indicated, edge obtusely angulated; markings formed by darker grey suffusion, viz., a very oblique central fascia narrow on costal third and broad on lower  $\frac{2}{3}$ , marked with a black longitudinal dash in middle, a spot on middle of costa, a triangular blotch on costa posteriorly not reaching apex, a transverse blotch from termen above tornus, and a spot on termen beneath apex: cilia grey-whitish, basal half barred with dark grey and limited by a blackish line. Hindwings with 6 and 7 closely approximated towards base; light grey, posteriorly suffusedly and obscurely strigulated with darker; central third of costa suffused with whitish as far as middle of cell; cilia grey-whitish, with grey subbasal shade.

S. AUSTR.: Mount Gambier, in November—TASM.: (Walker's types). I have described above my own single example, having

previously only given an incomplete description from the original types.

54. *A. ergophora*, n.sp.

♀. 26 mm. Head, palpi, and thorax fuscous mixed with white and ferruginous. Abdomen light fuscous. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, apex obtuse, termen distinctly sinuate, vertical, rounded beneath; whitish mixed with light grey and pale reddish-fuscous, and strewn with dark reddish-fuscous strigulae; markings formed by brownish suffusion, viz., a basal patch with outer edge angulated in middle, an oblique central fascia narrow towards costa and dilated into an irregular blotch below middle, and an elongate-triangular blotch extending along posterior half of costa, whence three strigae proceed towards tornus: cilia pale red-brownish barred with whitish, with a subbasal blackish line. Hindwings with 6 and 7 stalked; grey, posteriorly darker-strigulated; cilia grey-whitish, with grey subbasal line.

TAHM.: George's Bay, in January; one specimen. The distinct sinuation of termen of forewings is a marked characteristic.

55. *A. signigerana* Walk.

(*Tortrix signigerana* Walk., Cat. xxviii., 332.)

♂ 24-25 mm., ♀ 27-28 mm. Head, palpi, and thorax grey or brownish mixed with dark fuscous, tips of patagia whitish. Abdomen fuscous. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, with fold in ♂ not reaching  $\frac{1}{2}$ , apex obtuse, termen almost straight, nearly vertical, rounded beneath; white, more or less sprinkled especially anteriorly with grey or brownish, and strewn throughout with black or dark fuscous strigulae; basal patch partially suffused with fuscous or grey, sometimes ochreous-tinged, outer edge angulated; markings rather dark fuscous, somewhat mixed with deep ferruginous towards costa, viz., a very oblique central fascia narrow on upper half and broad on lower half but becoming less marked towards dorsum, lower half edged above by a black dash, a small spot on middle of costa connected by a striga with posterior



edge of central fascia, a triangular blotch extending along posterior  $\frac{2}{3}$  of costa, connected beneath with a transverse blotch resting on termen above tornus, and a spot extending along upper half of termen; space above middle of disc included between these dark markings in ♀ suffused with pale ochreous: cilia ochreous-whitish, indistinctly barred with grey, with a blackish subbasal line. Hindwings with 6 and 7 approximated towards base; light grey, in ♀ posteriorly obscurely darker strigulated; a whitish costal space from  $\frac{1}{4}$  to  $\frac{3}{4}$ ; cilia whitish, with light grey subbasal shade.

VIC.: Gisborne (Lyll), Beaconsfield (Drake), Melbourne (Raynor); in December, January, and April, seven specimens. This species is quite distinct from *A. rudis* Walk., with which I confused it in my former paper; it is broader-winged, with the costal fold of ♂ much shorter, and the ochreous discal suffusion is in this species characteristic of the ♀, but in *A. rudis* of the ♂.

56. *A. cerasta*, n.sp.

♂ 21-22 mm., ♀ 27 mm. Head, palpi, and thorax brownish more or less mixed with dark grey irroration, and thorax posteriorly with whitish. Abdomen light fuscous. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, with fold in ♂ reaching  $\frac{1}{3}$ , apex obtuse, termen slightly rounded, little oblique; grey, more or less mixed irregularly with white, partially suffused with pale ochreous-yellowish, and strewn with blackish strigulae; markings formed by dark brown or dark fuscous suffusion, viz., a basal patch with outer edge angulated but sometimes little marked, a very oblique central fascia, narrow on costal third and broad on lower  $\frac{2}{3}$ , connected above middle with a triangular blotch on posterior  $\frac{2}{3}$  of costa, an irregular transverse blotch resting on termen above tornus, and a spot on termen beneath apex; a more or less marked black longitudinal dash crossing middle of central fascia, subcostal area above this often suffused with yellow-ochreous: cilia light brownish mixed with whitish and sometimes indistinctly barred with pale grey, with a blackish subbasal line. Hindwings with 6 and 7 short-

stalked; grey, upper part of cell and costa above it more or less suffused with yellow-whitish, apical half of wing strigulated with darker grey; cilia grey, becoming grey-whitish towards dorsum, with a dark grey subbasal line.

Q.: Toowoomba, in October (Turner); four specimens. Smaller and rather broader-winged than *A. lignigerana*, which it most resembles; the costal fold in ♂ longer, there is more tendency to yellowish colouring, and veins 6 and 7 of hindwings are stalked.

#### 57. *A. rudis* Walk.

(*Sciaphila rudisana* Walk., Cat. xxviii., 349; *Penthina indecretana* ibid. 377; *Acropolitis signigerana* Meyr., (nec Walk.) Proc. Linn. Soc. N. S. Wales, 1881, 438.)

♂ 17-22 mm., ♀ 24-26 mm. Forewings narrower than usual in the genus, termen more rounded and more oblique; costal fold in ♂ reaching  $\frac{2}{3}$ ; black discal dash always well-marked, ♂ showing more or less ochreous suffusion above it, ♀ always without ochreous suffusion; costal triangular patch connected with post-tornal blotch into an irregular fascia; hindwings with 6 and 7 stalked.

Q.: Brisbane (Turner), Toowoomba—N.S.W.: Tenterfield (Turner), Sydney, Cooma (3000 feet)—VIC.: Gisborne (Lyell), Melbourne, Healesville—TASM.: Hobart—S. AUST.: Mount Lofty, from July to November, and in January and February.

#### 58. *A. lignigerana* Walk.

(*Podisca lignigerana* Walk., Cat. xxviii., 380; *Sciaphila inconcisana* ibid. 352; *Acropolitis lignigerana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 437.)

♂ 24-26 mm., ♀ 27-32 mm. Forewings with costal fold in ♂ not reaching  $\frac{1}{2}$ , termen almost straight, nearly vertical; hindwings with 6 and 7 approximated.

Q.: Duaringa (Barnard), Brisbane (Turner)—S. AUST.: Mount Lofty, Balaklava (Guest); from September to December. As the type of *S. inconcisana* is in very poor condition and was formerly thought unidentifiable, and the name *lignigerana* is now well-

known for this species, I retain the latter, their publication having been simultaneous.

59 *A. passalotana* Meyr.

(*Acropolitis passalotana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 436.)

Forewings shorter and broader than any other, termen faintly sinuate, somewhat oblique; hindwings with 3 and 4 unusually remote, almost parallel, 6 and 7 stalked.

Q.: Toowoomba, 2000 feet, in September. Still unique.

14. *ASTHENOPTYCHA* Meyr.

*Asthenoptycha* Meyr., Proc. Linn. Soc. N. S.

Wales, 1881, 461 ... .. type *hemicyptana*.

*Anatropia* Meyr., Proc. Linn. Soc. N.S. Wales,

1881, 463 ... .. type *craterana*.

Antennæ in ♂ ciliated. Palpi moderate, curved, ascending (especially in ♂), second joint with scales appressed above, more or less rough-scaled beneath, terminal short, erect. Thorax with well-developed crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 stalked.

An endemic genus, of which the species are similar and liable to be confused.

60. *A. epiglypta*, n.sp.

(*Asthenoptycha conjunctana* Meyr., (nec Walk.) Proc. Linn. Soc. N. S. Wales, 1881, 462.)

N.S.W.: Mount Kosciusko, 5000-6000 feet.—VIC.: Beaconsfield (Lyell)—TASM.: Launceston, Deloraine; from October to January.

61. *A. conjunctana* Walk.

(*Sciaphila conjunctana* Walk., Cat. xxviii., 348.)

♂. 17-20 mm. Head, palpi, and thorax brownish sprinkled with dark fuscous. Antennal ciliations 8. Abdomen light greyish-ochreous mixed with grey. Forewings elongate-triangular,

costa gently arched, fold rudimentary, apex obtuse, termen slightly sinuate, somewhat oblique; fuscous-whitish, suffusedly irrorated with fuscous, more or less strigulated and striated with dark fuscous; markings dark brown mixed with blackish; a moderate basal patch, outer edge obtusely angulated in middle; central fascia broad, oblique, narrower towards costa, bifurcate on lower half, suffused with blackish in middle, posterior edge in one specimen with irregular prominence in middle; dorsal space between basal patch and central fascia more or less distinctly paler and ochreous-tinged; three small spots on costa posteriorly, first sometimes giving rise to a more or less developed striga: cilia fuscous, at tornus mixed with whitish-ochreous. Hindwings grey; cilia pale grey or whitish-grey, with darker subbasal shade.

N.S.W.: Moust Kosciusko, 4500-4700 feet—VIC.: Gisborne (Lyell), Beaconsfield (Drake)—TASM.: Deloraine, George's Bay; in December, January, March, and April. The pale ochreous-tinged dorsal space is characteristic.

#### 62. *A. hemicryptana* Meyr.

(*Asthenoptycha hemicryptana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 461.)

Q.: Brisbane, Rosewood, Toowoomba—N.S.W.: Glen Innes (4500 feet); from September to December.

#### 63. *A. craterana* Meyr.

(*Anatropia craterana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 464.)

N.S.W.: Blackheath (3500 feet), Mount Kosciusko (4700 feet); in January.

#### 64. *A. iriodes* Low.

(*Anatropia iriodes* Low., Proc. Linn. Soc. N.S. Wales, 1898, 48.)

VIC.: Gisborne (Lyell); in November, December, and February. Distinct by the conspicuous white area; as Mr. Lower remarks, it imitates birds' droppings.

65. *A. asphaltica*, n.sp.

♀. 17 mm. Head and thorax brownish-ochreous mixed with fuscous, thoracic crest strong, dark fuscous. (Palpi broken.) Abdomen rather dark fuscous. Forewings elongate, somewhat dilated posteriorly, costa slightly arched, apex obtuse, termen slightly sinuate, somewhat oblique; fuscous-whitish; markings formed by blackish striae irregularly mixed with deep yellow-ochreous and filled up with leaden-grey; a moderate basal patch, outer edge obtusely angulated above middle; an indistinct stria beyond this; central fascia rather broad, little oblique, on lower half subconfluent with a conical præternal spot so as to appear dilated; a triangular apical patch, its anterior margin running from  $\frac{2}{3}$  of costa to tornus, somewhat broken up towards costa: cilia dark bronzy-fuscous, towards tornus paler-mixed. Hindwings rather dark fuscous, towards base lighter and somewhat fulvous-tinged; cilia fuscous.

N.S.W.: Sydney (Manly Beach), in February; one specimen. As the palpi are broken, the generic location is not assured, but probably correct.

15. *RHOMBOCEROS*, n.g.

Antennæ in ♂ moderately ciliated, basal third much thickened with dense projecting scales above and beneath, serrate. Palpi moderate, porrected, second joint much expanded with long dense projecting scales above and beneath, terminal concealed. Thorax with posterior crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 stalked, 5 almost parallel, 6 and 7 stalked.

Differs from *Capua* by the peculiar antennæ.

66. *R. nodicornis*, n.sp.

♂. 12 mm. Head and thorax light greyish-ochreous mixed with brownish, face dark fuscous. Palpi brownish, internally blackish. Antennæ whitish-ochreous, basal thickened portion suffused with dark fuscous. Abdomen brownish-ochreous, apical tuft very large, suffused with dark fuscous. Forewings elongate,

posteriorly dilated, costa slightly arched, with fold reaching to beyond middle, and an expansible hair-pencil from base resting on this outside (besides the usual hairs inside), apex obtuse, termen hardly sinuate, vertical, rounded beneath; pale fuscous; costal half of fold and tuft fuscous, lower half whitish-ochreous; markings dark fuscous mixed with light ochreous-yellowish and obscurely margined with whitish-ochreous; an irregular spot in disc indicating angle of basal patch; central fascia represented by a transverse spot extending from middle of disc to near dorsum, its upper extremity enlarged; a narrow somewhat sinuate fascia running from  $\frac{3}{4}$  of costa to tornus, its upper extremity furcate and enclosing a fuscous spot; a small dark fuscous spot on costa towards apex, space between this and fascia fuscous; some strigulae along upper half of termen: cilia whitish-ochreous. Hindwings along costa from base to near apex with fringe of long pale brownish hair-scales directed downwards over surface; bronzy-fuscous with a faint reddish tinge; cilia whitish-ochreous faintly tinged with reddish.

N.G.: Sariba I. (Meek); one specimen.

#### 16. *ACROCEUTHES* Meyr.

*Acroceuthes* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 458 ... .. type *metaxanthana*.

Antennae in ♂ ciliated. Palpi moderate, porrected, second joint with projecting scales above and beneath, in ♂ above with large expansible fringe of long hair-scales, terminal short, concealed. Thorax without crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 stalked.

A specialised form of *Capua*, sufficiently characteristic for distinction.

#### 67. *A. metaxanthana* Walk.

(*Cacoecia metaxanthana* Walk., Cat. xxviii., 315; *Sciaphila projectana*, ib. 352; *Carpocapsa trajectana*, ib. xxx., 992; *Acroceuthes metaxanthana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 458).

Q. : Brisbane—N.S.W. : Newcastle, Sydney—VIC. : Beaconsfield (Drake); from August to March.

17. *AKOLOSTOMA*, n.g.

Antennæ in ♂ ciliated. Palpi in ♂ long, cylindrical, with appressed scales, normally porrected but erectile, towards base of second joint with scales projecting above to form a small tuft, terminal joint moderate; in ♀ moderate, porrected, second joint with projecting scales above and beneath. Thorax without crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 towards base, 6 and 7 stalked.

Also a modification of *Capua*.

68. *A. scutiferana* Meyr.

*Capua scutiferana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 456.

Q. : Goodna (Turner), Rosewood—N.S.W. : Sydney, Kangaroo Valley; in September, October, and January.

18. *LAMYRODES*, n.g.

Antennæ in ♂ minutely ciliated. Palpi moderately long, porrected, with appressed scales tapering to a point anteriorly, terminal joint concealed. Thorax without crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 4 absent, 5 approximated to 3 at base, 6 and 7 closely approximated towards base.

Correlated to *Capua*.

69. *L. phileris*, n.sp.

♂. 16 mm. Head, palpi, and thorax ochreous-brownish, face paler. Abdomen pale greyish-ochreous mixed with grey. Forewings elongate, rather narrow, posteriorly slightly dilated, costa gently arched, without fold, apex obtuse, termen somewhat sinuate, oblique; ochreous-brownish tinged with ferruginous; costa with some dots of dark fuscous scales anteriorly and

scattered short whitish strigulae posteriorly; a moderate oblique somewhat darker central fascia indicated on costal half only; a line of dark brown scales along termen: cilia pale ochreous-yellowish, towards base whitish. Hindwings pale fuscous, slightly yellowish-tinged; cilia ochreous-whitish.

N. Aust.: Mount Lofty (Guest); one specimen.

#### 19. CAPUA Steph.

- Capua* Steph., Ill. Brit. Ent. iv., 171 (1834) ... type *favillaceana*.  
*Epagoge* Hb., Verz. 389 (1826) ... (?) type *grotiana*.  
*Dichelia* Guen., Micr. Ind. 7 (1845) ... type *grotiana*.  
*Teratodes* Guen., Micr. Ind. 34 (1845) ... type *favillaceana*.  
*Sperchia* Walk., Char. Het. 83 (1869) ... type *intractana*.  
*Epitymbia* Meyr., Proc. Linn. Soc. N. S. Wales,  
 1881, 657 ... type *alaudana*.

Antennae in ♂ ciliated. Palpi moderate or long, porrected, second joint with more or less projecting scales above and beneath, terminal short. Thorax usually with slight crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 connate or seldom stalked, 5 approximated to 4 at base, 6 and 7 stalked.

A considerable genus of Indo-Malayan origin, but now more largely developed in Australia than in any other region. I do not adopt the name *Epagoge*, because (1) the application of it is dubious, as I do not admit the principle of accidental fixation by Stephens' use, and (2) I hold that the name *Capua*, which has over 70 years' use in a sense undoubtedly correct, is not to be overridden by an obsolete name now revived.

#### 70. *C. alaudana* Meyr.

(*Epitymbia alaudana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 658.)

N.S.W.: Parramatta, in September. Still unique.

#### 71. *C. phellodes*, n.sp.

♀. 12 mm. Head, palpi, and thorax pale brownish-ochreous. (Abdomen broken.) Forewings elongate, hardly dilated poste-



riorly, costa gently arched, apex obtuse, termen straight, oblique; whitish-ochreous, irregularly striated with fuscous; markings fuscous tinged with yellowish; a moderate basal patch, outer edge rather curved, irregular; central fascia represented by two dorsal blotches with a pale space between them, a dark fuscous costal blotch, and a dark fuscous transverse di-calc mark between these; a moderate fascia from  $\frac{1}{2}$  of costa to termen above tornus, broadest on costa where it forms a dark fuscous blotch, and marked in disc with several blackish strigulae: cilia whitish-ochreous mixed with fuscous and dark fuscous. Hindwings rather dark grey; cilia grey, with darker subbasal shade.

N.S.W.: Gosford, in November (Lyell); one specimen. Type in Coll. Lyell.

72. *C. periopa*, n.sp.

♀. 20-22 mm. Head, palpi, thorax, and abdomen dark fuscous. Forewings elongate, costa anteriorly moderately arched, posteriorly nearly straight, apex obtuse, termen slightly rounded, oblique; brownish, somewhat mixed with leaden-grey and ferruginous; markings dark brown mixed with ferruginous and dark grey, and strigulated with black; a moderate basal patch, outer edge angulated in middle but partially confluent beneath with an irregular spot on dorsum beyond it; a moderately broad central fascia not reaching dorsum; an irregular longitudinal black streak rising from this in middle of disc and more or less extended towards termen, posterior portion sinuate downwards; a subtriangular costal patch extending from middle to  $\frac{2}{3}$ ; a small spot on costa beyond this; an irregular undefined streak along termen: cilia brownish mixed with dark fuscous and blackish. Hindwings with 3 and 4 stalked; orange; a terminal fascia of dark fuscous suffusion, broadest at apex; dorsum suffused with fuscous; cilia fuscous, with dark fuscous subbasal shade.

N.S.W.: Narrabeen (Lyell), Parramatta (Raynor)—Vic.: Gisborne (Lyell), Lilydale; from September to November and in April, four specimens.

73. *C. cosmopsis* Low.

(*Dichelia cosmopsis* Low., Trans. Roy. Soc. S. Austr. 1894, 87.)

♂♀. 14-17 mm. Antennæ in ♂ strongly ciliated. Forewings in ♂ with costal fold; variable in development of white marking between basal patch and central fascia, sometimes obsolete in ♀. Hindwings variable in extent of dark fuscous terminal suffusion.

N.S.W.: Sydney—Vic.: Gisborne(Lyell), Sale(Miss M. Wise), Melbourne—S. Austr.: Mount Gambier(Guest); in March and April.

74. *C. plathanana* Meyr.

(*Capua plathanana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 457.)

♂♀. Sexes similar.

N.S.W.: Sydney; in October, December, and February.

75. *C. diemeniana* Zell.

(*Conchylis diemeniana* Zell., Hor. Ross. xiii., 138.)

♂♀. 11-13 mm. Antennal ciliations of ♂ minute. Forewings in ♂ without costal fold; basal  $\frac{2}{3}$  ochreous-yellow, rest dark fuscous. Hindwings with basal  $\frac{2}{3}$  yellowish, rest fuscous. Very distinct on this brief diagnosis.

Q.: Brisbane(Turner)—N.S.W.: Sydney(Lyell)—Vic.: Healesville(Lucas)—Tasm.: without locality(Zeller); in October and April, apparently not common.

76. *C. pentacosma* Low.

(*Anatropia pentacosma* Low., Proc. Linn. Soc. N. S. Wales, 1900, 409.)

Vic.: Castlemaine(Drake), Healesville(Lucas)—S. Austr.: Blackwood(Lower); in March. Handsome and distinct; Lower's description is correct, though not very clear.

77. *C. pentazona* Low.

(*Capua pentazona* Low., Trans. Roy. Soc. S. Austr. 1901, 75.)

♂. 15-16 mm. Head, palpi, and thorax dark fuscous. Antennal

ciliations 1. Abdomen dark grey. Forewings elongate, costa gently arched, without fold, apex round-pointed, termen slightly sinuate, oblique; glossy fuscous; about seven or eight irregular rather oblique dark fuscous striae strewn with whitish-yellowish brassy-tinged linear scales, and two or three additional strigae towards costa: cilia fuscous. Hindwings rather dark fuscous; cilia grey, with darker subbasal shade. Undersurface of hindwings suffused with whitish.

♀. Palpi whitish beneath. Thorax partially suffused with yellow-whitish. Forewings with striae stronger and blacker, more largely mixed and suffused with yellow-whitish; ground-colour paler, towards costa suffused with white, but with basal patch, central fascia, and a transverse semioval costal patch darker fuscous.

TASM.: Hobart (Norman), Zeehan (Findlay), Deloraine: in October and November, three specimens, viz., Lower's original female type, and two males, which notwithstanding the apparent dissimilarity, owing to the absence of white suffusion, I think are probably referable here.

78. *C. parastactis*, n.sp.

♂. 12-14 mm. Head and palpi grey. Antennal ciliations minute. Thorax whitish-ochreous, more or less mixed with pale grey except on patagia, tips of patagia whitish. Abdomen grey. Forewings elongate, costa moderately arched, without fold, apex round-pointed, termen sinuate, oblique; rather light glossy grey; about seven or eight irregular much broken oblique transverse blackish-fuscous lines suffusedly edged with pale ochreous-yellowish, one from  $\frac{2}{3}$  of costa to tornus forming a thicker entire streak: cilia light glossy grey, tips whitish. Hindwings grey; cilia whitish-grey, with grey basal line.

♀. Forewings with groundcolour largely suffused with white, except on a moderate central fascia, and triangular costal patch confluent with the dark postmedian streak.

TASM.: Deloraine; in November and December, eight specimens. Nearly allied to *C. pentazona*, but differs structurally by the minute antennal ciliations of ♂.

79. *C. isographa*, n.sp.

♂. 13-14 mm. Head, palpi, thorax, and abdomen bronzy-grey. Antennal ciliations  $\frac{3}{4}$ . Forewings elongate, posteriorly hardly dilated, costa slightly arched, without fold, apex obtuse, termen almost straight, oblique; pale grey, irregularly striated with dark fuscous; markings suffused with darker grey or fuscous; a moderate basal patch, outer edge straight, rather oblique; space between this and central fascia sometimes whitish-tinged; central fascia moderate, dilated towards dorsum, posterior edge irregular, with strong triangular incision above middle; an undefined patch occupying whole apical area, and including four small dark fuscous costal spots: cilia pale greyish, basal half sprinkled with dark fuscous. Hindwings grey, obscurely darker-strigulated; cilia light grey, with darker subbasal shade.

Vic.: Gisborne(Lyell); in March, two specimens. Type in Coll. Lyell.

80. *C. cnaphalides*, n.sp.

♂. 13 mm. Head and thorax whitish, crest mixed with blackish. Palpi whitish, second joint externally irrorated with blackish. Antennæ subdentate, ciliations  $\frac{1}{2}$ . (Abdomen broken.) Forewings elongate, posteriorly considerably dilated, costa slightly arched, bent about middle, with fold reaching to middle, apex obtuse, termen straight, rather oblique; pale whitish-fuscous mixed with pale brown-reddish, with about ten irregular oblique stræ of fuscous irroration mixed with black; an oblique patch from dorsum towards base, a very undefined central fascia, and triangular costal patch slightly indicated by fuscous suffusion: cilia whitish, with fuscous shade mixed with black. Hindwings whitish, suffusedly and coarsely strigulated with grey; cilia whitish, with grey subbasal shade.

Vic.: Lorne(Lyell); in February, one specimen. Type in Coll. Lyell.

81. *C. nummulata*, n.sp.

♂. 10-11 mm. Head and thorax whitish-ochreous, shoulders more or less bronzy-ochreous, thoracic crest mixed with blackish.

Palpi bronzy-ochreous sprinkled with fuscous. Antennal ciliations 1. Abdomen light greyish-ochreous. Forewings elongate, posteriorly slightly dilated, costa slightly arched, with fold reaching beyond  $\frac{1}{2}$ , apex obtuse, termen slightly rounded, rather strongly oblique; pale yellow-ochreous, with about twenty small bright leaden-metallic spots arranged in about five irregular transverse series, last partly terminal; markings very indefinite, ferruginous sprinkled with blackish; a streak along costal fold; an oblique patch from dorsum near base, reaching  $\frac{3}{4}$  across wing; a moderate very oblique central fascia, strongly marked towards costa but nearly obsolete dorsally, a triangular costal patch, space between this and central fascia whitish-tinged; a streak along termen: cilia pale ochreous-yellowish, with bronzy-ochreous subbasal shade. Hindwings with 3 and 4 stalked; grey-whitish, thinly scaled, veins suffused with grey; cilia grey-whitish, with grey subbasal line.

Q.: Toowoomba(Turner); in September, two specimens.

82. *C. pseudarcha*, n.sp.

♂♀. 13-14 mm. Head and thorax ochreous-whitish, in ♂ more or less suffused with yellow-ochreous. Palpi with long rough scales, ochreous-whitish, second joint centrally suffused with ochreous. Antennal ciliations in ♂  $\frac{1}{2}$ . Abdomen ochreous-whitish, in ♀ with dense anal tuft. Forewings elongate, somewhat dilated posteriorly, costa gently arched, in ♂ without fold, apex obtuse, termen almost straight, oblique; ochreous-whitish, sometimes more or less suffused with pale ochreous-yellowish, sometimes suffusedly strigulated with yellow-ochreous between the markings; markings yellow-ochreous, variable in depth and development, partially slightly sprinkled with blackish specks on margins; some indications of strigulae of blackish irroration along costa; basal patch more or less indicated, outer edge angulated in middle, slightly blackish-marked on angle; central fascia moderate, very oblique, posterior edge nearly straight, irregular, more or less well-marked, anterior edge suffused on lower half; a more or less defined subtriangular patch on costa about  $\frac{1}{2}$ ; a

streak along termen: cilia whitish-ochreous, with traces of a fuscous line, at tornus with a few blackish scales. Hindwings grey-whitish, strigulated with pale grey; cilia grey-whitish.

W. Austr.: Perth, Albany; from October to December, four specimens. Exceedingly similar to *C. decolorana*, yet certainly distinct by the absence of costal fold in male.

### 83. *C. decolorana* Walk.

(*Grapholita decolorana* Walk., Cat. xxviii., 392; *Capua decolorana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 447.)

N.S.W.: Sydney, Bulli Pass, Blackheath (3500 feet)—Vic.: Healesville; from September to November, and in February. Other recorded localities are based on confusion with allied species. From the following species it may be distinguished by the whitish hindwings; it is a common Sydney insect, and appears to be constant.

### 84. *C. euphona*, n.sp.

♂♀. 13-15 mm. Head and thorax whitish-ochreous, shoulders more or less suffused with yellow-ochreous. Palpi yellow-ochreous, above and beneath white. Antennal ciliations of ♂  $\frac{1}{2}$ . Abdomen light grey, in ♀ with dense anal tuft. Forewings elongate, posteriorly dilated, costa gently arched, in ♂ with fold reaching beyond  $\frac{1}{2}$ , apex obtuse, termen almost straight, oblique; white, basal half more or less suffused with pale ochreous-yellowish; markings deep ochreous; some costal strigulae sprinkled with blackish; an irregular spot in disc indicating angle of basal patch, edged with black scales externally; a moderate very oblique central fascia, undefined anteriorly, especially towards dorsum, posteriorly edged with black scales in disc; a rounded-quadrilateral costal patch at  $\frac{3}{4}$ , more or less edged or sprinkled with dark fuscous, and containing a small whitish costal spot; a light ochreous-yellowish streak along termen, sometimes slightly sprinkled with dark fuscous; cilia whitish-yellowish. Hindwings grey, faintly darker-strigulated; cilia light grey, with darker basal shade.

Q.: Brisbane, Stanthorpe(Turner)—N.S.W.: Bathurst—VIC.: Gisborne, Macedon, Beaconsfield (Lyell)—TASM.: Launceston, Deloraine, Hobart; from October to March, twenty specimens.

85. *C. acritodes*, n.sp.

♂♀. 12-16 mm. Head and thorax whitish-ochreous, sometimes faintly greyish-tinged. Palpi pale ochreous mixed with grey, above and beneath whitish. Antennal ciliations in ♂  $\frac{1}{2}$ . Abdomen light grey, in ♀ with dense anal tuft. Forewings elongate, posteriorly slightly dilated, costa gently arched, in ♂ with fold reaching  $\frac{1}{3}$ , apex obtuse, termen almost straight, oblique; grey-whitish sometimes tinged with yellowish, more or less indistinctly strigulated throughout with grey; markings grey, sometimes tinged with yellowish, more or less sprinkled with dark fuscous or blackish; an irregular spot in disc indicating angle of basal patch; a moderate oblique central fascia, anterior edge ill-defined, posterior well-marked; a very indefinite rounded-quadrilateral costal patch at  $\frac{3}{4}$ ; traces of a streak along termen: cilia ochreous-whitish with two grey shades. Hindwings light grey, faintly darker-strigulated; cilia whitish-grey, with darker basal shade.

VIC.: Casterton—S. AUST.: Adelaide, Wirrabara, Port Lincoln; in October and November, ten specimens. Nearly allied to the preceding, but with greyer markings, and structurally distinct by the obviously shorter costal fold of male.

86. *C. ammochroa* Low.

(*Capua ammochroa* Low., Trans. Roy. Soc. S. Aust., 1893, 167.)

S. AUST.: Glen Osmond, Blackwood(Lower); in September and October. This and the following species are the only two of which I have not seen types; I am unable to identify them, but they appear to belong here.

87. *C. leucospila* Low.

(*Capua leucospila* Low., Trans. Roy. Soc. S. Aust., 1893, 167.)

S. AUST.: Glen Osmond, Golden Grove(Lower); in September and October. Unknown to me; appears to be a distinct species, allied to the following.

88. *C. phryctora*, n.sp.

♂♀. 11-14 mm. Head and thorax brownish-ochreous sometimes mixed with fuscous. Palpi rather long, brownish-ochreous, white towards base beneath. Antennæ in ♂ dentate, ciliations 2. Abdomen grey. Forewings elongate, posteriorly somewhat dilated, costa slightly arched, with fold reaching  $\frac{1}{3}$ , apex obtuse, termen faintly sinuate, oblique; brownish-ochreous or brownish, sometimes largely suffused with white; markings darker ferruginous-brown sprinkled with black; an oblique transverse blotch from dorsum towards base, reaching  $\frac{3}{4}$  across wing; central fascia moderately broad, oblique, usually less marked and partially obsolete on lower half, upper half terminated by a black spot below middle of disc; a rounded-transverse costal patch about  $\frac{1}{4}$ , reaching  $\frac{2}{3}$  across wing, costal space between this and central fascia forming a more or less defined white triangle; a suffused streak along termen: cilia brown mixed with dark grey, outer half between apex and tornus pale ochreous-yellowish beyond a dark fuscous line. Hindwings dark fuscous; cilia light grey or whitish, with dark fuscous subbasal shade.

W. Austr.: Albany; in September and October, seven specimens. Nearly allied to *C. deuterastis*, but differently and more deeply coloured, and distinguished by black discal spot below upper half of central fascia.

89. *C. deuterastis*, n.sp.

♂. 13-14 mm. Head and thorax ochreous, partially whitish-tinged. Palpi rather long, ochreous, beneath white. Antennæ dentate, ciliations 2. Abdomen grey. Forewings elongate, posteriorly somewhat dilated, costa slightly arched, with fold reaching  $\frac{1}{3}$ , apex obtuse, termen nearly straight, oblique; whitish-ochreous, suffusedly strigulated throughout with brownish-ochreous, sometimes finely sprinkled with dark fuscous; markings ochreous-grey; an oblique patch from dorsum near base, reaching  $\frac{3}{4}$  across wing; a moderately broad central fascia, becoming obsolete on lower half; a semioval costal patch containing a whitish



costal dot, space between this and central fascia whitish-mixed or in one specimen forming a clear white costal triangle; a suffused streak along termen: cilia grey mixed with brownish-ochreous, outer half pale ochreous-yellowish between apex and tornus beyond a dark fuscous line. Hindwings grey; cilia whitish, with grey subbasal shade.

W. AUST.: Perth; in October, four specimens.

90. *C. dryina*, n.sp.

♂♀. 12-15 mm. Head, palpi, and thorax whitish-ochreous or pale brownish-ochreous. Antennæ in ♂ dentate, ciliations 1. Abdomen grey. Forewings elongate, more so in ♀, in ♂ somewhat dilated posteriorly, costa gently arched, in ♂ with fold reaching  $\frac{2}{3}$ , apex obtuse, termen almost straight, oblique, more so in ♀; light brownish ochreous, sometimes slightly reddish-tinged, often more or less strigulated with grey; dorsal edge dotted with blackish scales; markings varying from fuscous to ferruginous-brown, sometimes more or less mixed with black in disc, in ♀ indistinct or often wholly obsolete; some irregular marking in disc indicating angle of basal patch; central fascia moderate, very oblique, obsolete on dorsal half; a large triangular costal patch extending from middle of costa to near apex: cilia whitish-yellowish with two more or less indistinct grey shades, apical third clear. Hindwings grey-whitish distinctly strigulated with grey; cilia whitish, with pale grey subbasal shade.

TASM.: Deloraine—W. AUST.: Waroona (Berthoud), Albany; from September to November, twelve specimens.

91. *C. tarachota*, n.sp.

♂♀. 12-14 mm. Head and thorax ochreous, variable in tint, thorax sometimes sprinkled with brown. Palpi ochreous, sometimes mixed or partly suffused with fuscous. Antennæ in ♂ dentate, ciliations 1. Abdomen light grey. Forewings elongate, posteriorly dilated, costa gently arched, in ♂ with fold reaching to middle, apex obtuse, termen straight, oblique; light brownish-ochreous or red-brownish; markings ferruginous, more or less

mixed with fuscous and dark fuscous and sprinkled with blackish; a basal patch more or less marked, with outer edge angulated in middle; a moderate oblique central fascia, rather dilated downwards; a triangular costal patch extending from beyond middle to near apex, on costa marked with dark and pale spots; a variable transverse spot or streak resting on termen above tornus; some blackish scales along termen: cilia whitish-ochreous, with a subbasal interrupted shade of ferruginous and dark fuscous scales. Hindwings light grey, faintly strigulated with darker; cilia whitish, with grey subbasal shade.

W. Aust.: Perth, Albany; from September to December, seven specimens.

92. *C. ephedra*, n.sp.

♀. 16 mm. Head and thorax ochreous-whitish. Palpi fuscous, margins mixed with whitish. (Abdomen broken.) Forewings elongate, hardly dilated posteriorly, costa gently arched, apex obtuse, termen faintly sinuate, oblique; ochreous-whitish; some scattered blackish dots on costa and dorsum, accompanied by slight brown suffusion; markings rather dark fuscous, mixed with ferruginous and on costal half with blackish; a moderate rather oblique central fascia; a triangular costal patch extending from beyond middle to near apex, space between it and central fascia fuscous mixed with ferruginous; some scattered ferruginous and fuscous scales on terminal area: cilia whitish-ochreous. Hindwings whitish, suffusedly spotted throughout with light grey; cilia whitish, with grey basal line.

Tasm.: Mount Wellington, 1500 feet; at the beginning of February, one specimen. Allied to *C. dryina*, but not a variety of it, the central fascia being differently placed, less oblique and broader, entire.

93. *C. hemicosmana* Meyr.

(*Capua hemicosmana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 449.)

Vic.: Macedon (Lyell), Wandin (Jarvis), Warragul; from October to December.

94. *C. oxygona* Low.

(*Capua oxygona* Low., Proc. Linn. Soc. N. S. Wales, 1899, 92.)

N.S.W.: Broken Hill(Lower); in October. Much like *C. vacuana*, but with palpi longer, head not dark, forewings obviously longer and narrower, hindwings whitish. Subsequently Mr. Lower, by an oversight, described a different species also as *Capua oxygona* (Trans. Roy. Soc. S. Aust. 1908, 115.)

95. *C. vacuana* Walk.

(*Conchylis vacuana* Walk., Cat. xxviii., 367; *Grapholita mutata* ib. 393; *Capua vacuana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 448.)

Q.: Duaringa(Barnard), Toowoomba, Brisbane—N.S.W.: Sydney, Bulli—Vic.: Melbourne—Tasm.: Launceston; from August to April.

96. *C. fusciceps* Walk.

(*Conchylis fuscicepsana* Walk., Cat. xxviii., 364; *C. cepsana* ib. 366; *C. mundulana* ib. 368; (?) *C. albidana* ib. xxx., 987; *Dichelia fusciceps* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 473.)

Q.: Brisbane, Toowoomba—N.S.W.: Narrabeen, Ourimbah, Lilyvale(Lyell), Sydney, Bulli; from September to May.

97. *C. clarana* Walk.

(*Dichelia clarana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 475.)

N.S.W.: Sydney, Blackheath (3500 feet)—Vic.: Gisborne, Beaconsfield, Lorne(Lyell), Melbourne—Tasm.: Deloraine, Campbelltown, George's Bay, Hobart—S. Aust.: Mount Gambier (Guest); from December to March.

98. *C. solana* Walk.

(*Teras solana* Walk., Cat. xxviii., 300; *Dichelia solana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 476.)

Q.: Brisbane—N.S.W.: Sydney, Bulli—Vic.: Wandin(Jarvis), Melbourne; from August to December, and in April.

99. *C. thernaterrima* Low.

(*Dichelia thernaterimma* (err. ac prav.) Low., Trans. Roy. Soc. S. Aust., 1893, 168.)

♂♀ 12-15 mm. Head and thorax brownish-ochreous, sometimes suffused with fuscous. Palpi brownish-ochreous more or less mixed with dark fuscous. Antennal ciliations of ♂ 1. Abdomen grey. Forewings elongate, rather narrow, not dilated posteriorly, costa gently arched, in ♂ without fold, apex obtuse, termen slightly rounded, oblique; brownish-ochreous mixed with light brown-reddish, in one ♀ suffused with fuscous, more deeply and irrorated with dark fuscous posteriorly; basal patch more or less marked with dark fuscous, outer edge obtusely angulated above middle; central fascia moderate, oblique, dark fuscous edged with blackish, towards dorsum broader, less marked or nearly obsolete, more or less mixed with brown-reddish, posterior edge semicircularly excavated above a longitudinal more or less developed blackish mark in middle; costal patch flattened-triangular, dark fuscous marked with blackish, with three small dark spots on costa; some dark fuscous strigulae towards termen: cilia pale brownish-ochreous, on basal half more or less barred with grey and blackish, in the dark ♀ basal half suffused with fuscous and dark fuscous. Hindwings grey, darker posteriorly; cilia light grey, with darker subbasal shade.

Vic.: Gisborne, Lorne(Lyell)—S. Aust.: Mount Lofty(Lower); in March and April. Lower quotes Tasmania as a locality on my authority, but this was based upon a supposed identification of mine which I now think mistaken. I have redescribed the species from three specimens (one male, two females) received from Lower and Lyell; it is an obscure insect, but seems to be a good species. The orthography of the name adopted is that intended by the author.

100. *C. hyperetana* Meyr.

(*Dichelia hyperetana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 479; *Palaeobia orepusculana* ib. 668; *Dichelia diptheroides* Low., Trans. Roy. Soc. S. Aust. 1902, 252.)

VIC.: Warragul(Raynor), MacedoA(Lyell), Birchip(Goudie), Healesville—TASM.: Launceston, Deloraine, Hobart; in November and December. Both sexes taken abundantly in Tasmania; varies in development of markings, but always distinct from the preceding.

101. *C. montivagana* Meyr.

(*Dichelia montivagana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 477.)

N.S.W.: Sydney, Blackheath (3500 feet), Nowra—VIC: Gisborne(Lyell), Melbourne—TASM.: Deloraine, George's Bay—S. AUST.: Mount Lofty; from November to March.

102. *C. argillosana* Meyr.

(*Dichelia argillosana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 479.)

VIC.: Melbourne(Raynor). This distinct species is still unique.

103. *C. atristrigana* Meyr.

(*Dichelia atristrigana* Meyr., Proc. Linn. Soc. N.S.Wales, 1881, 478; *D. lunifera* Low., Trans. Roy. Soc. S. Aust, 1908, 321.)

N.S.W.: Broken Hill(Lower), Lilyvale, Como(Lyell), Parramatta; in March and April.

104. *C. intractana* Walk.

(*Sperchia intractana* Walk., Char. Het. 82; *Capua sordidatana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 454; *C. obfuscata* ib. 455.)

Q.: Duaringa(Barnard), Brisbane, Toowoomba—N.S.W.: Sydney, Wollongong, Kiama—VIC.: Melbourne(Raynor), Gisborne(Lyell)—TASM.: Deloraine—S. AUST.: Adelaide(Guest); all the year except May.

105. *C. mersana* Walk.

(*Teras mersana* Walk., Cat. xxviii., 298; *Capua chimerinana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 452.)

N.S.W.: Moruya(Murray), Sydney—VIC.: Kewell(Hill), Wandin(Jarvis), Gisborne, Beaconsfield, Lorne(Lyell), Melbourne—

TASM.: Launceston (Lyell), Hobart (Lea), Deloraine, George's Bay—S. AUST.: Mount Gambier, Mount Lofty (Guest)—W. AUST.: Bridgetown (Bracken), Waroona (Berthoud), Albany, from September to June.

106. *C. montanana* Meyr.

(*Chapua montanana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 451.)

♀. 13 mm. Smaller than ♂ type, but otherwise similar.

N.S.W.: Blackheath, Mount Victoria (3500 feet); in November and March.

107. *C. placodes* Low.

(*Chapua placodes* Low., Proc. Linn. Soc. N. S. Wales, 1899, 93.)

♂. 20-21 mm. Head whitish-ochreous or greyish ochreous, tips of scales whitish. Palpi fuscous, more or less suffused above with ochreous-whitish. Antennæ dentate, ciliations 1. Thorax reddish-ochreous-brown mixed with whitish. Abdomen pale whitish-ochreous, sometimes sprinkled with grey. Forewings elongate, rather narrow, posteriorly dilated, costa slightly arched, with fold almost reaching middle, apex obtuse, termen slightly rounded, oblique; pale ochreous, more or less tinged with light red-brownish, sometimes partially sprinkled with grey; markings ochreous-brown sometimes mixed with grey; costal fold strigulated with blackish; basal patch sometimes marked with black, narrowest on dorsum, outer edge rather acutely angulated in middle; a semioval spot on middle of dorsum; central fascia moderate, oblique, with a strong angular prominence in middle of posterior edge, marked with a longitudinal median black dash which extends into this prominence and is there edged above with white; costal blotch formed by three small costal spots connected with an irregular longitudinal spot beneath them; an elongate spot extending along lower  $\frac{2}{3}$  of termen: cilia whitish-ochreous, more or less barred on basal half with dark fuscous, on costa whitish barred with dark fuscous. Hindwings grey or light grey, obscurely darker-strigulated posteriorly; cilia whitish, with grey subbasal shade.

N.S.W.: Broken Hill(Lower); from September to December. Lower's description is not satisfactory; I have therefore redescribed the species from the original type and a second fine specimen received from Mr. Lower. The species is allied to *C. montanana*, but distinct.

108. *C. leptospila* Low.

(*Cupua leptospila* Low., Trans. Roy. Soc. S. Aust. 1901, 74.)

♂. 19 mm. Head white. Forewings with costal fold reaching middle; fuscous much mixed with white, with coarse scattered dark fuscous strigulae; basal patch undefined; central fascia moderate, oblique, indicated by absence of white mixture, marked with a dark fuscous spot in middle; four small rather dark fuscous spots on costa posteriorly, and an elongate transverse spot before lower portion of termen: cilia whitish, barred on basal half and on costa with rather dark fuscous. Hindwings pale whitish-grey, faintly darker-strigulated; cilia white, with interrupted greyish subbasal shade.

N.S.W.: Broken Hill(Lower); in May. I have thought it necessary to redescribe this also from the type; it is allied to the preceding.

109. *C. notographa*, n.sp.

♀. 18-19 mm. Head, palpi, and thorax fuscous irrorated with whitish-ochreous, thorax mixed with ferruginous. Abdomen ochreous-whitish mixed with grey. Forewings elongate, somewhat dilated posteriorly, costa slightly arched, apex obtuse, termen straight, oblique; pale whitish-ochreous, more or less sprinkled with whitish; markings dark grey, more or less mixed with ferruginous-brown and edged with black; a narrow oblique fascia from dorsum towards base, nearly reaching costa; an elongate spot extending nearly over central third of dorsum; central fascia moderate, very oblique, posterior edge deeply emarginate above middle; costal patch semioval, marked on costa with three small dark spots separated by spots of groundcolour; a small spot on costa before apex; a thick streak close before termen on lower  $\frac{2}{3}$ , sometimes connected beneath with central

fascia: cilia whitish-ochreous, round apex tinged with reddish-ochreous, with dark fuscous bars above and below apex. Hindwings whitish, coarsely strigulated and spotted with grey; cilia grey-whitish.

VIC.: Birchip(Goudie); in April, two specimens Type in Coll. Lyell.

#### 110. *C. ceramica* Low.

(*Capua ceramica* Low., Trans. Roy. Soc. S. Aust. 1908, 115.)

♂. 19-20 mm. Palpi unusually long. Forewings with costal fold rather broad, reaching  $\frac{1}{3}$ ; characterised by obsolescence of basal patch and central fascia. Hindwings whitish-grey, spotted and strigulated with grey.

VIC.: Monbulk(Lower), Beaconsfield(Lyell), Wandin(Jarvis); in August and September.

#### 111. *C. debiliana* Walk.

(*Sciaphila debiliana* Walk., Cat. xxviii., 351; *S. sidneyana* ib. 352; *Capua melancrocana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 450.)

N.S.W.: Sydney—VIC.: Gisborne(Lyell), Castlemaine(Drake)—S. AUST.: Mount Lofty (Guest)—W. AUST.: Waroona (Berthoud), York; from August to October.

#### 112. *C. scotinopa* Low.

(*Dichelia scotinopa* Low., Trans. Roy. Soc. S. Aust. 1902, 235.)

♂♀. 18 mm. Antennal ciliations in ♂ minute. Forewings in ♂ without costal fold. A distinct species, sufficiently characterised by Lower.

VIC.: Stawell(Lower), Gisborne(Lyell); in March and April.

#### 113. *C. ophthalmias*, n.sp.

♂♀. 21-23 mm. Head and palpi in ♂ grey, in ♀ brownish-ochreous mixed with dark red-brown. Antennæ in ♂ dentate, ciliations 1. Thorax in ♂ reddish-brown, in ♀ dark purplish-fuscous mixed on shoulders with dark red-brown. Abdomen



grey. Forewings elongate, in ♂ posteriorly dilated, in ♀ suboblong, costa gently arched, in ♂ with fold reaching to near middle, apex obtuse, termen in ♂ hardly sinuate, rather oblique, in ♀ sinuate, little oblique; in ♂ reddish-brown, in ♀ rather dark purple-grey, obscurely strigulated with dark red-brown; costa more or less strigulated with blackish; basal patch in ♂ somewhat darker, outer edge indicated in disc by a transverse streak of blackish scales; a patch of pale suffusion above middle of disc, sometimes whitish-mixed, edged beneath by a thick black down-curved streak extending more than  $\frac{1}{2}$  of length of wing, anterior extremity in ♂ connected with costa by a fuscous spot and posterior by a triangular fuscous costal patch which is trifurcate on costa: cilia reddish-brown, in ♀ mixed with dark purple-fuscous. Hindwings in ♂ whitish-grey spotted with grey, in ♀ grey strigulated with darker; cilia pale grey, with darker sub-basal shade.

N.S.W.: Hazelbrook(Lyeil)—Vic.: Melbourne(Kershaw); in April, three specimens.

114. *C. isoscelana* Meyr.

(*Dichelia isoscelana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 470.)

N.S.W.: Blackheath (3500 feet), Bulli Pass—Vic.: Gisborne, Beaconsfield(Lyell), Wandin(Jarvis), Melbourne—Tasm.: Zeehan (Findlay)—S. Aust.: Mount Lofty; in October and November.

115. *C. disputana* Walk.

(*Sciaphila disputana* Walk., Cat. xxviii., 349; *Dichelia disputana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 472.)

N.S.W.: Sydney; in February, March, and from June to September.

116. *C. paraloza*, n.sp.

♂. 14-16 mm. Head, palpi, and thorax brownish-ochreous; scales of palpi rather appressed beneath. Antennal ciliations minute. Abdomen ochreous-whitish, sometimes tinged with grey. Forewings elongate, suboblong, costa moderately arched,

without fold, apex obtuse, termen faintly sinuate, rather oblique; pale brownish-ochreous, more or less tinged with light brown-reddish; markings rather dark brown; a basal patch more or less partially indicated, outer edge straight, oblique: central fascia moderate, very oblique, anterior edge straight, well-marked, posterior very indefinite, broadest and most distinct towards dorsum, narrower on dorsum itself; a straight well-marked streak from  $\frac{3}{4}$  of costa to termen above tornus, beyond which is some slight dark suffusion and scattered dark fuscous strigulae: cilia whitish-ochreous, basal half more brownish-ochreous, becoming darker and greyish towards apex. Hindwings grey-whitish, towards apex slightly ochreous-tinged, with some faint grey strigulae; cilia grey-whitish, with faint grey subbasal shade.

N.S.W.: Lawson(Lyell)—VIC.: Beaconsfield (Lyell); in November, March, and April, three specimens.

#### 117. *C. placoxantha* Low.

(*Anisogona placoxantha* Low., Trans. Roy. Soc. S. Aust. 1896, 160.)

♂♀. 13-16 mm. Antennal ciliations of ♂ 1. Forewings in ♂ without fold. A very distinct species, recognisably described by Lower, but the pale costal spot between central fascia and costal patch is usually white more or less tinged with ochreous towards costa, not yellow.

VIC.: Gisborne, Beaconsfield, Macedon, Lorne(Lyell), Stawell (Lower), Healesville—TASM.: Zeehan(Findlay), Hobart; from October to December, and in February. Allied to the following species.

#### 118. *C. oxygrammana* Meyr.

(*Acroceuthes oxygrammana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 460.)

♂♀. 15-16 mm. Antennal ciliations of ♂  $\frac{3}{4}$ . Forewings in ♂ without fold. Sexes quite similar.

VIC.: Macedon (Lyell), Beaconsfield (Drake)—TASM.: Hobart, Evandale(Raynor); from November to January.

119. *C. epiloma* Low.

(*Capua epiloma* Low., Trans. Roy. Soc. S. Aust. 1902, 235.)

♂. 15-16 mm. Palpi long. Antennal ciliations 2. Forewings with costal fold narrow, not reaching  $\frac{1}{3}$ . Lower's description is otherwise sufficient.

N.S.W.: Bathurst(Lower), Katoomba(Lyell)—VIC.: Macedon(Lyell); in November and December.

120. *C. effulgens*, n.sp.

♂. 15 mm. Head, palpi, and thorax bronzy-ochreous. Antennal ciliations 1. Abdomen grey. Forewings suboblong, costa anteriorly rather strongly, posteriorly slightly arched, without fold, apex obtuse, termen slightly sinuate, rather oblique; bronzy, ochreous suffusedly mixed with dark grey, towards middle of disc yellower and less mixed with grey; a suffused light ochreous-yellow costal patch extending from  $\frac{1}{3}$  to  $\frac{4}{5}$ , narrowed to extremities. Hindwings rather dark grey.

TASM.: Zeehan(Findlay); in February, one specimen, in poor condition, but a very distinct species. Type in Coll. Lyell.

121. *C. leucostacta*, n.sp.

♂♀. 14-16 mm. Head, palpi, and thorax brownish-ochreous or ferruginous-brownish, variably sprinkled with grey; palpi long. Antennal ciliations of ♂ 1. Abdomen whitish-ochreous mixed with grey. Forewings elongate, suboblong, costa anteriorly rather strongly, posteriorly slightly arched, in ♂ without fold, apex obtuse, termen hardly sinuate, somewhat oblique; brownish-ochreous or brownish, in ♀ mixed or strigulated with ferruginous, obscurely and suffusedly strigulated with grey, with a few blackish scales; costal edge more or less white, irregularly strigulated with blackish-grey; dorsum dotted with white and blackish-grey, with a small white spot before tornus; in ♀ a pale yellow patch reticulated with ferruginous-orange extending along dorsum from  $\frac{1}{4}$  to near tornus, widest in middle and narrowed to extremities: cilia brownish with two dark grey shades. Hind-

wings with 3 and 4 short-stalked; whitish strigulated with grey, in ♀ suffused with light grey; cilia whitish with gray subbasal shade.

N.S.W.: Lawson(Lyell)—Vic.: Beaconsfield(Drake); in November, December, and April, seven specimens (4♂, 3♀).

## 20. ARISTOCOSMA Meyr.

*Aristocosma* Meyr., Proc. Linn. Soc. N. S. Wales,  
1881, 427 ... .. type *chrysophilana*.

Antennæ in ♂ strongly ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal moderate. Thorax with posterior crest. Forewings with 3 from considerably before angle, 7 and 8 stalked, 7 to termen. Hindwings somewhat narrower than forewings, with 3 from considerably before angle, remote from 4, 4 from angle, 5 rather approximated to 4, 6 and 7 long-stalked.

Contains only the single species; probably a development of *Adoxophyes*.

## 122. *A. chrysophilana* Walk.

(*Cacoecia chrysophilana* Walk., Cat. xxviii., 315; *Aristocosma chrysophilana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 428.)

Q.: Brisbane(Illidge), Stradbroke Island(Turner)—N.S.W.: Newcastle, Sydney; from August to November. The species varies somewhat; Mr. Lyell has a specimen with the costal edge of forewings pale yellowish, but otherwise no pale central costal blotch.

## 21. ATELODORA Meyr.

*Atelodora* Meyr., Proc. Linn. Soc. N. S. Wales,  
1881, 426 ... .. type *psilochytana*.

Antennæ in ♂ shortly ciliated. Palpi moderately long, porrected, second joint dilated with rough scales above and beneath, terminal moderate. Thorax without crest. Forewings with 7 absent. Hindwings with 3 from before angle, tolerably remote from 4, 5 approximated to 4, 6 and 7 stalked.

Only two closely allied species are known. The genus is correlated to the following,

123. *A. pelochytana* Meyr.

(*Atelodora pelochytana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 427.)

Q.: Brisbane(Turner)—N.S.W.: Murrurundi, Newcastle(Raynor)—TASM.: Deloraine; from August to December, and in March. At Brisbane, according to examples of both generations sent by Dr. Turner, the spring (August) form is normal, whilst the autumn (March) form is very much smaller (9 mm.), but not otherwise different.

124. *A. agramma* Low.

(*Atelodora agramma* Low., Proc. Linn. Soc. N. S. Wales, 1900, 408.)

S. AUST.: Adelaide(Lower); in October. Nearly allied to the preceding, but quite distinct by the much darker hindwings and cilia.

22. *PROCALYPTIS*, n.g.

Palpi moderate, porrected, second joint rough-scaled above and beneath, terminal moderate. Thorax without crest. Forewings with 7 and 8 stalked, 7 to termen. Hindwings with 3, 4, 5 approximated at base, 6 and 7 closely approximated towards base.

Only the following species is known.

125. *P. oncota*, n.sp.

Q. 18 mm. Head and thorax reddish-ochreous-brown. Palpi ochreous-whitish tinged with reddish-fuscous. Abdomen pale brownish. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, apex obtuse, termen slightly rounded, hardly oblique; reddish-brown, obscurely strigulated with darker ochreous-brown, interspaces somewhat mixed with pale grey: cilia glossy brownish-ochreous, darker towards base.

Hindwings pale fuscous obscurely suffused with whitish-yellowish except on margins; cilia pale greyish-ochreous.

W. Aust.: Northampton; in November, one specimen.

### 23. *ADOXOPHYES* Meyr.

*Adoxophyes* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 429 ... .. type *heteroidana*.

Antennæ in ♂ shortly ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal moderate. Thorax without crest. Forewings with 3 from considerably before angle, 7 and 8 long-stalked, 7 to termen. Hindwings with 3 from considerably before angle, remote from 4, 5 approximated to 4, 6 and 7 stalked.

An Indo-Malayan and Australian genus, whose centre of development seems to lie in the region of New Guinea.

### 126. *A. tripselia* Low.

(*Capua tripselia* Low., Trans. Roy. Soc. S. Aust. 1908, 318.)

♂ 12-16 mm., ♀ 16-20 mm. Head dark fuscous, back of crown whitish. Distinct by whitish groundcolour of forewings, and whitish hindwings; markings of forewings edged with dark fuscous, partially filled with variable fuscous suffusion, and more or less marked with brownish-ochreous on veins, in ♀ usually more or less obsolete except two fuscous spots on costa representing central fascia and costal patch; hindwings in ♀ faintly ochreous-tinged, with apex more or less grey.

N.G.: Sariba Island (Meek)—Q.: Cairns (Dodd); in October and November.

### 127. *A. ioterma*, n.sp.

♂. 12-14 mm. Head and thorax whitish-ochreous more or less mixed with ferruginous. Palpi ferruginous-ochreous. Abdomen whitish-ochreous. Forewings rather short and broad, costa moderately arched, with broad fold reaching  $\frac{2}{3}$ , apex obtuse, termen almost straight, vertical, rounded beneath; whitish-ochreous, more ochreous along costa, with a few scattered ferru-

ginous strigulæ; lower half of basal patch irregularly marked with ferruginous; other markings brownish outlined with ferruginous; central fascia moderate, very oblique, gradually dilated towards dorsum, extending as a broad streak along costa to base; a somewhat curved fascia from  $\frac{2}{3}$  of costa to termen above tornus, moderately broad in middle and narrowed to extremities, anterior edge curved-prominent beneath costa, posterior edge projecting in middle so as to touch costa near apex: cilia yellowish. Hindwings in Australian form whitish, in New Guinea and St. Aignan examples pale grey tinged with yellowish, in those from Sudest Island rather dark grey; cilia whitish, in darker examples tinged with grey.

N.G.: Samarai, St. Aignan Island, Sudest Island (Meek)—Q.: Cairns (Dodd); from September to November, nine specimens.

128. *A. heteroidana* Meyer.

(*Adoxophyes heteroidana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 429.)

Q.: Rosewood; in September and December.

129. *A. bematica*, n.sp.

Q. 23-25 mm. Head, thorax, and abdomen pale whitish-ochreous. Palpi light yellow-ochreous. Forewings suboblong, costa anteriorly strongly arched, posteriorly nearly straight, apex obtuse, termen sinuate, vertical; pale whitish-ochreous; edge of basal patch and of a narrow central fascia indicated only by a few small dark ferruginous-fusca strigulæ; an elongate-triangular brown patch marked with dark fuscous and grey extending along costa from  $\frac{2}{3}$  to near apex, from posterior side of which two series of dark ferruginous-fusca strigulæ converge to termen above tornus: cilia light fulvous-ochreous, becoming ochreous-whitish towards tornus. Hindwings and cilia ochreous-whitish, cilia slightly yellowish-tinged round apex.

SOLOMON ISLANDS: Treasury I. (Meek); two specimens.

130. *A. vindicata*, n.sp.

♀. 17 mm. Head, thorax, and abdomen whitish-ochreous. Palpi pale ochreous-yellowish, towards base with some brownish scales. Forewings suboblong, costa anteriorly strongly arched, thence nearly straight, apex obtuse, termen sinuate, nearly vertical; whitish-ochreous; basal patch indicated by median and subdorsal ferruginous streaks; central fascia represented by dark fuscous triangular costal and dorsal spots connected by a ferruginous stria, the costal spot also sending a straight ferruginous streak to tornus; a triangular dark fuscous spot on costa about  $\frac{1}{2}$ , whence a ferruginous gradually attenuated streak runs to termen above tornus: cilia whitish-ochreous tinged with yellowish. Hindwings ochreous-whitish; cilia ochreous-whitish, in middle of termen with a greyish-ochreous spot.

S.I.: Choiseul(Meek); one specimen.

131. *A. melichroa* Low.

(*Capua melichroa* Low., Proc. Linn. Soc. N. S. Wales, 1899, 92.)

♂ 15-16 mm., ♀ 18-21 mm. Head and thorax whitish-ochreous or ochreous-yellow. Forewings with basal patch sometimes marked with several dark ferruginous-fuscous strigulae towards dorsum; central fascia very narrow, narrowest and sometimes interrupted in disc, rather dark purplish-fuscous mixed with ferruginous; posterior fascia often more or less interrupted in middle. Hindwings whitish-yellowish; cilia in ♀ with a thickened whitish-ochreous spot below middle of termen, centrally tinged with grey.

N.G.: Kei Islands—Q.: Cairns(Dodd), Mackay(Lower); from September to December, and in April. Also occurs in Burma.

132. *A. epizeucta*, n.sp.

♂ 15 mm., ♀ 16-18 mm. Head, palpi, and thorax ochreous-yellowish, thorax posteriorly suffusedly mixed with ferruginous. Abdomen pale ochreous. Forewings in ♂ rather short and broad, in ♀ suboblong, costa moderately arched, in ♂ with broad



fold reaching  $\frac{2}{5}$ , apex obtuse, termen almost straight, vertical, rounded beneath; whitish-ochreous, partially slightly sprinkled with pale reddish-fuscous, costa suffused with ferruginous-yellowish and marked with a few fuscous strigulae; markings dark ferruginous-brown; basal patch represented by an oblique striga not reaching margins and a longitudinal streak or patch below submedian fold; central fascia narrow, straight, oblique, posterior edge irregular and dilated on dorsum; a narrow fascia from  $\frac{1}{3}$  of costa to termen above tornus, broadest towards costa: cilia pale ochreous-yellowish. Hindwings ochreous-whitish, in ♀ faintly greyish-tinged towards dorsum; cilia whitish-yellowish, in ♀ with a thickened patch of grey scales in a sinuation below middle.

S.I.: Isabel I.(Meek), two females(type)—N.G.: Woodlark I., in April(Meek), one male.

133. *A. panxantha* Low.

(*Capna panxantha* Low., Trans. Roy. Soc. S. Aust. 1901, 75.)

♀. 16-20 mm. Head and thorax ochreous, thorax sometimes sprinkled with fuscous. Forewings yellow-ochreous, with pale glistening iridescence, strigulated with darker; markings more or less indicated by dark reddish-fuscous irroration, indefinite; basal patch with outer edge oblique, sometimes obsolete; central fascia very narrow, oblique: a triangular costal patch, with traces of a connection with termen above tornus: cilia yellow-ochreous. Hindwings ochreous, dorsal third tinged with fuscous.

♀.: Cooktown (Lower)—N. Aust.: Port Darwin (Bleeker); in February.

134. *A. templana* Pag.

(*Tortrix templana* Pag., Zoologica xxix., 225.)

♀. 17-20 mm. Head and thorax ochreous-yellow, sometimes marked with ferruginous-orange. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, apex obtuse, termen almost straight, vertical; yellow, strigulated with ferruginous-orange; markings formed by suffusion of similar

strigulae, variably spotted or suffused with fuscous and sprinkled with black; basal patch very ill-defined, much widest on dorsum, edge angulated below middle, sometimes connected at this point by dark suffusion with central fascia; central fascia narrow, oblique, abruptly dilated posteriorly on dorsum to reach tornus; costal patch suboblong, lower anterior angle distinct and sometimes connected by a thick bar with middle of central fascia, lower posterior angle sending a more or less marked gradually diminishing streak to termen above tornus: cilia yellow. Hindwings whitish-ochreous, sometimes slightly tinged with fuscous towards dorsum; cilia whitish-ochreous.

S.I.: New Georgia, Treasury I., Guadalcanar (Meek)—BISMARCK ISLANDS: Kinigunang, New Britain—N.G.: Woodlark I. (Meek)—N. AUST.: Port Darwin.

### 135. *A. fasciculana* Walk.

(*Tortrix fasciculana* Walk., Cat. xxxv., 1785; *Adoxophyes cyrtosoma* Meyr., Trans. Ent. Soc. Lond. 1886, 276; *Capua epipepla* Low., Trans. Roy. Soc. S. Aust. 1908, 318.)

TONGA (Mathew)—FIJI (Lucas)—S.I.: Guadalcanar, Isabel I. (Meek)—N.G.: St. Aignan I. (Meek)—MOLUCCAS: Ceram—Q.: Cairns (Dodd); in November and December.

### 136. *A. privatana* Walk.

(*Dichelia privatana* Walk., Cat. xxviii., 320.)

Much like *A. fasciculana*, with similarly broad costal fold and large anal tuft of ♂; forewings with ground-colour more or less wholly suffused with fuscous, margins of fasciae straighter and more regular (not so sinuate-curved), edge of basal patch defined throughout, furcate branches of central fascia narrower; hindwings grey, tinged with ochreous towards costa (in *A. fasciculana* light fulvous-ochreous).

N.G.: Fergusson I.; in October, one specimen. Common in India, Burma, and Ceylon.

24. *HOMONA* Walk.

*Homona* Walk., Cat. xxviii, 424(1863)... ... type *coffearia*.

*Ericia* Walk., Cat. xxxv., 1802(1866) ... ... type *æstivana*.

*Anisogona* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 464 ... ... type *similana*.

Antennæ in ♂ ciliated. Palpi rather short, ascending, with appressed scales, terminal joint short. Thorax without crest. Forewings with 3 from angle, 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 stalked.

A development of *Cacoccia*, to which it closely approaches. Besides the following, there are a few closely allied Indo-Malayan species. The typical *H. coffearia* is a highly prolific and injurious pest of tea-plantations in Ceylon.

137. *H. mediana* Walk.

(*Pandemis mediana* Walk., Cat. xxviii, 311.)

♂♀. 18-20 mm. Head and thorax reddish-fuscous or reddish-grey, sides of crown tinged with whitish. Antennal ciliations in ♂ 1. Abdomen grey. Forewings elongate, posteriorly dilated, costa anteriorly moderately arched, in ♂ without fold, posteriorly in ♂ almost straight, in ♀ slightly sinuate, apex obtuse, termen sinuate, rather oblique; brownish, reddish-fuscous, or reddish-grey, with transverse series of darker strigulae except in darkest specimens; basal patch and central fascia sometimes obscurely darker but usually obsolete; costal patch darker, triangular, sometimes obsolete; sometimes a semioval blotch of dark fuscous suffusion extending over posterior  $\frac{2}{3}$  of dorsum: cilia rather dark fuscous, with a whitish tornal patch. Hindwings grey; costal half whitish, with some small scattered grey spots, towards apex tinged with ochreous; apex itself sometimes suffused with grey; cilia grey-whitish, with grey subbasal line.

N.S.W.: Blackheath, 3500 feet—VIC.: Beaconsfield, Lorne (Lyell), Healesville—TASM.: Deloraine, Hobart—S. AUSTR.: Mount Lofty; from October to December, and in March. Forewings

narrower anteriorly than in *H. similana*, with costa less arched and termen more oblique, and easily known by costal half of hindwings whitish, not grey or yellow, in ♀ without thickening of costal cilia towards apex.

138. *H. similana* Walk.

(*Teras similana* Walk., Cat. xxviii., 300; *Anisogona similana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 466.)

Q.: Brisbane, Warwick (Turner), Toowoomba—N.S. W.: Moruya, Hawkesbury (Lyell), Newcastle, Sydney, Bulli—Vic.: Geelong (Trebilcock), Melbourne—S. Austr.: Mount Lofty (Guest); from August to October, and from January to May. Hindwings in ♀ with distinct thickening of costal cilia towards apex.

139. *H. homoyama* n.sp.

♀. 13-16 mm. Head, palpi, and thorax pale brownish-ochreous. Abdomen light grey. Forewings suboblong, costa anteriorly strongly arched, posteriorly sinuate, apex obtuse, termen rather strongly sinuate, somewhat oblique; pale brownish-ochreous tinged with brown-reddish; two oblique transverse slightly curved brownish-ochreous lines or streaks sometimes more or less sprinkled with dark brown, representing edge of basal patch and anterior margin of central fascia; a flattened-triangular fuscous costal patch mixed with dark brown and black extending on costa from middle to  $\frac{1}{2}$ , from apex of which a third similar streak runs to tornus; some dark brown strigulae towards apex: cilia pale brownish-ochreous, with light brown-reddish suffused shade, on costa with a small blackish antepical spot. Hindwings rather dark grey, sometimes faintly reddish-tinged; cilia pale grey, with darker subbasal shade.

N.G.: St. Aignan I. (Meek)—Q.: Cairns (Dodd); in November, five specimens.

140. *H. simana* Meyr.

(*Anisogona simana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 465.)

N.S.W.: Newcastle(Raynor), in September. I have seen no further specimens, but I am informed by Mr. J. H. Durrant, who has examined the single male, now in Lord Walsingham's collection, that it possesses a costal fold, which I failed to detect.

141. *H. fistulata*, n.sp.

♂15 mm., ♀18 mm. Head and thorax ochreous-whitish, face and palpi dark brown. Antennæ in ♂ minutely ciliated. Abdomen whitish-ochreous, in ♀ dorsally suffused with light fuscous. Forewings suboblong, shorter and broader in ♂, costa anteriorly strongly arched, in ♂ without fold, posteriorly in ♂ slightly arched, in ♀ nearly straight, apex obtuse, termen slightly sinuate, nearly vertical; vein 1c bent up and shortly anastomosing with 2 near origin, stalk of 7 and 8 very long; in ♂ whitish-ochreous, in ♀ brownish-ochreous tinged with grey; edge of basal patch indicated by a curved brown line; a small semicircular dark brown spot on middle of costa; a slightly incurved brown line from middle of disc to middle of dorsum; four very small dark brown spots or elongate marks on costa posteriorly; a few small scattered dark brown strigulae towards termen: cilia in ♂ whitish-ochreous, in ♀ pale ochreous mixed with grey. Hindwings in ♂ whitish-ochreous, slightly fulvous-tinged towards apex, in ♀ fuscous, becoming pale fulvous-ochreous posteriorly; some small scattered grey spots posteriorly; cilia as in forewings.

Q.: Cairns(Dodd), in September and October, five specimens.

142. *H. aestivana* Walk.

(*Ericia aestivana* Walk., Cat.xxxv., 1803; *E. posticana* ib.1803.)

♂. 26-30 mm. Head, palpi, and thorax pale yellow-ochreous more or less mixed or suffused with reddish-brown. Antennal ciliations 1. Abdomen hairy, ochreous-yellow. Forewings suboblong, posteriorly markedly dilated, costa slightly arched, without fold, apex obtuse, termen faintly sinuate, little oblique; reddish-ochreous-fuscous; costa sometimes suffused with ferruginous; basal area sometimes irregularly suffused with dark fuscous, tending to unite with an irregular spot of ferruginous

or dark fuscous suffusion above and before middle of disc; sometimes a short blackish streak along upper part of termen: cilia reddish-ochreous-fuscous. Hindwings ochreous-orange; cilia ochreous-yellowish tinged with reddish-fuscous.

♀. 30 mm. Forewings formed as in *H. mermerodes* ♀; light ochreous-brown, with scattered dark fuscous strigulae. Hindwings ochreous-yellow; cilia grey-whitish, greyer towards base.

N.G.: Fakfak, St. Aignan I. (3 males), Woodlark I. (1 female) (Meek); in November and April. Also from the Philippines. The female specimen is conjecturedly referred to this species on account of the yellow hindwings; but it might be a variety of *H. mermerodes*; the sexes in this genus differ so much that it is difficult to be sure of their identity unless taken together.

143. *H. mermerodes*, n.sp.

♂. 21-26 mm. Head, palpi, and thorax pale greyish-ochreous or brownish-ochreous, variably mixed or suffused with fuscous or reddish-brown. Antennal ciliations 1. Abdomen hairy, greyish-ochreous or grey. Forewings suboblong, slightly dilated posteriorly, costa moderately arched, faintly sinuate in middle, without fold, apex obtuse, termen faintly sinuate beneath apex, bowed, rather prominent; pale greyish-ochreous or brownish-ochreous, often variably tinged or mixed with ashy-fuscous or light brown-reddish; sometimes the dark suffusion is confined to costal or dorsal area; lower part of basal patch sometimes represented by a blotch of dark suffusion; central fascia often indicated by an irregular spot edged with dark fuscous or deep ferruginous above middle, sometimes narrowly connected with costa; usually a narrow apical patch of dark suffusion, often edged on lower half by a dark fuscous streak and marked on costa with some small dark fuscous spots: cilia varying from whitish-ochreous to pale fuscous. Hindwings rather dark grey; cilia varying from grey to grey-whitish.

♀. 29-36 mm. Forewings oblong, costa very abruptly arched towards base, posteriorly slightly sinuate, apex round-pointed,

prominent, termen concave below apex, rounded-prominent beneath; brownish-ochreous, brownish, reddish-fuscous, or rather dark ashy-fuscous tinged with reddish, darker specimens sometimes strigulated with dark fuscous; anterior edge of central fascia sometimes indicated towards costa by a dark fuscous oblique striga; usually two or three dark fuscous elongate marks on costa posteriorly; sometimes indications of blotches of dark suffusion towards dorsum posteriorly, and on apical area, but these are quite indefinite: cilia varying from pale ochreous to grey, sometimes with dark grey subbasal shade. Hindwings fuscous or rather dark fuscous, usually more or less tinged with orange-fulvous, sometimes strongly; cilia greyish.

S.I.: Rendova, Gizo—N.G.: Fakfak, Mailu, Sudest I., St. Aignan I., Goodenough I., Trobriand I., Rossel I., Fergusson I., Woodlark I. (Meek)—Q.: Cairns (Dodd); in April, July, November, and December; twenty-six specimens (12♂, 14♀). Both sexes are very variable in colour.

144. *H. pharangitis*, n.sp.

♂. 16-17 mm. Head, palpi, and thorax fuscous. Antennal ciliations  $\frac{1}{2}$ . Abdomen pale greyish-ochreous. Forewings oblong, rather broad, costa anteriorly strongly arched, posteriorly straight, with broad semioval fold reaching from base to  $\frac{1}{3}$ , apex obtuse, termen sinuate, vertical; 1c bent and approximated to 2 near origin, stalk of 7 and 8 rather short; pale whitish-fuscous, with scattered brownish-ochreous strigulae mixed with fuscous and partially slightly tinged with reddish; a large basal patch of dark ashy-reddish-fuscous suffusion, its edge straight, oblique, suffused, running from  $\frac{1}{3}$  of costa to  $\frac{2}{3}$  of dorsum; in one specimen the dark strigulation obscurely indicates a triangular costal patch beyond middle: cilia whitish-ochreous somewhat mixed with light brown-reddish, with suffused grey subbasal shade. Hindwings fuscous, basal half darker fuscous; cilia pale fuscous, tip mixed with whitish.

Q.: Cairns (Dodd); in October and April, two specimens.

145. *H. spargotis*, n.sp.

♂. 17-18 mm. Head and thorax brownish-ochreous, face and palpi brownish. Antennal ciliations 1. Abdomen grey, anal tuft pale ochreous. Forewings oblong, costa anteriorly moderately arched, posteriorly straight, with broad semioval fold reaching to beyond  $\frac{1}{3}$ , apex obtuse, termen rounded, somewhat oblique; light brownish-ochreous, sprinkled with pale reddish-fuscous; costal fold suffused with reddish-fuscous irroration; a dorsal patch of dark fuscous or reddish-fuscous suffusion before central fascia; central fascia entire, reddish-fuscous, rather narrow towards costa, with a few black specks beneath costa, rather broadly dilated towards dorsum; an apical patch of reddish-fuscous suffusion, its anterior edge subconcave, running from  $\frac{3}{4}$  of costa to about middle of termen: cilia pale ochreous. Hindwings dark grey, extreme apex tinged with fulvous; cilia grey-whitish, with grey subbasal shade.

♀. 25-26 mm. Hardly differs from *H. phanæa* ♀; face and palpi irrorated with fuscous; forewings with costa more abruptly arched anteriorly, without sinuation before middle; edge of basal patch somewhat curved.

Q.: Cairns(Dodd)—N. Aust.: Port Darwin(Bleeser); in October, April, and May, six specimens.

146. *H. phanæa*, n.sp.

♂. 20-22 mm. Head and thorax brownish-ochreous or brownish, face and palpi ferruginous-brown. Antennal ciliations 1. Abdomen brownish-ochreous. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, with broad semioval fold reaching  $\frac{2}{3}$ , apex obtuse, termen slightly sinuate beneath apex, hardly oblique, rounded beneath; pale yellow-ochreous or brownish-ochreous, with scattered grey strigulae; costal fold brownish-ochreous, with several grey costal strigulae; rest of basal patch brownish-ochreous or dark brown, outer edge angularly produced on dorsum; central fascia represented by a rather small rounded-triangular fuscous spot edged with dark fuscous on costa before middle, and a quadrate fuscous blotch



edged laterally with brown on dorsum before tornus, anterior edge extended as a brown streak to above and before middle of disc; a somewhat curved brown streak from before  $\frac{2}{3}$  of costa to termen above tornus, apical area beyond this more or less suffused with fuscous, with three brown marks on costa posteriorly: cilia pale ochreous. Hindwings light orange-ochreous suffused with pale fuscous except towards costal area; cilia pale ochreous tinged with fuscous.

♀. 27-30 mm. Head, palpi, and thorax brownish ochreous. Abdomen light ochreous-orange. Forewings elongate-oblong, costa anteriorly strongly arched, slightly sinuate before middle and again on posterior half, apex rounded-prominent, termen concave beneath apex, little oblique, rounded beneath; brownish-ochreous, finely strigulated with fuscous; markings more or less partially infuscated, sometimes very slightly, edged with fine brown striae; basal patch with outer edge oblique, obtusely angulated above middle or almost straight; central fascia broad, oblique, rather narrowed towards costa; apical patch as in ♂ but less marked: cilia pale brownish-ochreous. Hindwings light ochreous-orange, towards termen sometimes tinged with fulvous; cilia concolorous.

S.I.: Isabel I., Rendova, Choiseul, Treasury I. (Meek)—N.G.: St. Aignan I. (Meek), Kei Is.; sixteen specimens.

## 25. CACÆCIA Hb.

*Cacæcia* Hb., Verz. 388(1826)... type *xylosteanæ*.

*Cryptoptila* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 481 ... type *australana*.

Antennæ in ♂ ciliated. Palpi rather short, ascending, with appressed scales, terminal joint short. Thorax without crest. Forewings with 3 from angle, 7 and 8 separate, 7 to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 approximated towards base.

This genus, being now separated from *Tortrix* by the difference in palpi instead of the costal fold, is much reduced in extent, so

far as Australian species are concerned; it contains, however, a considerable number of species in the Northern hemisphere. The name *Archips* Hb., lately revived for this genus by Lord Walsingham, being published wholly without characters, cannot be adopted, and being moreover obsolete for a century, is doubly barred

147. *C. thysanoma*, n.sp.

♂. 18-20 mm. Head, palpi, and thorax fuscous. Antennal ciliations  $\frac{1}{2}$ . Abdomen grey. Forewings suboblong, posteriorly hardly dilated, costa anteriorly gently arched, posteriorly nearly straight, with broad semioval fold not reaching  $\frac{1}{3}$ , apex obtuse, termen sinuate, little oblique; rather dark bronzy-fuscous; series of dark fuscous strigulae accompanied by some whitish-ochreous scales indicating edges of basal patch and broad rather oblique central fascia, and others towards apex and before termen; costal fold filled with curved expansible whitish hairs: cilia brownish suffusedly barred with dark grey, on tornus and at tips suffused with whitish-ochreous. Hindwings fuscous suffusedly strigulated with darker, towards costa especially posteriorly obscurely whitish-suffused between the dark strigulae; cilia whitish-grey, with dark grey subbasal shade.

Q.:Brisbane(Turner); three specimens.

148. *C. ursina*, n.sp.

♂. 19 mm. Head light greyish-ochreous. Palpi pale greyish-ochreous sprinkled with fuscous, above with white expansible hairs. Antennae light greyish-ochreous, ciliations  $\frac{1}{2}$ . Thorax light greyish-ochreous mixed with red-brown. Abdomen whitish-ochreous sprinkled with fuscous. Forewings oblong, costa anteriorly moderately arched, posteriorly nearly straight, costal fold rather broad, reaching  $\frac{1}{3}$ , apex obtuse, termen faintly sinuate, hardly oblique; fuscous or brownish, more or less tinged with reddish, towards costa mixed with pale greyish-ochreous, with scattered dark red-brown strigulae mixed with dark fuscous; markings deep red-brown mixed with blackish; basal patch rather small, formed of irregular strigulae, outer edge angulated

in middle; central fascia indicated on upper half by interrupted margins, and in disc by an oblique patch of suffusion, beneath this obsolete; costal patch moderate, semioval, well-defined, on costa marked with pale greyish-ochreous; a small costal spot beyond this: cilia fuscous mixed with red-brown. Hindwings grey, faintly darker-strigulated; cilia light grey, with darker subbasal shade.

Q.: Mount Tambourine(Turner); in November, two specimens.

#### 149. *C. polygraphana* Walk.

(*Tortrix polygraphana* Walk., Cat. xxviii., 330; *Cacæcia polygraphana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 495.)

Palpi in ♂ with expansible whitish hairs above; antennæ in ♂ whitish above, with a short black streak on stalk near base. This latter character is peculiar to the species, and will distinguish it from all similar insects. The species is nearly allied to the two preceding, and the resemblance to some species of *Tortrix* (*T. ferrea*, *T. pyrosemana*, and *T. laganodes*) is superficial only; the structural characters of palpi and broad costal fold afford clear distinctions.

Q.: Stanthorpe (Turner)—N.S.W.: Glen Innes (3500 feet), Blackheath (3500 feet), Bathurst (2500 feet), Mount Kosciusko (5000 feet)—VIC.: Mount St. Bernard(5000 feet), Beaconsfield, Gisborne (Lyell), Melbourne—TASM.: Launceston, Campbelltown, Deloraine, George's Bay, Hobart—S. AUSTR.: Mount Lofty, Balaklava, Mount Gambier(Guest); from November to March.

#### 150. *C. australana* Lew.

(*Tortrix australana* Lew., Ins. N. S. Wales 11, pl.17; *Teras immersana* Walk., Cat.xxviii., 302; *Cryptoptila immersana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 481, 535; *Cacæcia australana* ib. 485.)

Varies considerably; there is a common variety of ♂ with pale thorax and basal patch of forewings, which gives it a distinct appearance; also there is a form of ♀ in which the markings are quite as in normal ♂; the other and diverse form arises from this

by the development of pale variegation; all intermediates occur. The costal tuft of hindwings in ♀, though peculiar amongst Australian species, and unusually well-developed, occurs in a less conspicuous form in many other species of the genus.

Q.: Killarney(Turner), Rosewood—N.S.W.: Newcastle, Sydney—Vic.: Mount Macedon (3000 feet), Gisborne (Lyell), Melbourne, Trafalgar; from September to February. Larva on ivy (*Hedera*), honeysuckle(*Lonicera*), *Embothrium*, etc. Mr. Lyell found the larvæ gregarious, "hundreds together," in a great web on leaves of "mountain ash" on Mount Macedon, perhaps only due to unusual abundance, as I found them feeding separately.

## 26. *CHRESMARCHA*, n.g.

Head with appressed scales, face smooth. Antennæ in ♂ moderately ciliated. Palpi rather short, porrected, second joint shortly rough-scaled, terminal short. Thorax without crest. Forewings with 3 from considerably before angle, 7 and 8 in ♂ stalked, in ♀ separate, 7 to termen. Hindwings with 3 in ♂ remote from angle, parallel to 4, in ♀ approximated to 4, 5 rather approximated to 4, 6 and 7 short-stalked.

Type *C. sibyllina*. This and the next two genera belong to a curious group differing from the normal type of the family by their smooth heads and bright colouring, but otherwise entirely conformable; they appear to be a development of *Tortrix*.

## 151. *C. delphica*, n.sp.

♂. 21 mm. Head and palpi orange. Thorax pale whitish-yellow. Abdomen pale ochreous, two apical segments blackish. Forewings elongate, suboblong, costa without fold, towards base strongly, posteriorly slightly arched, apex obtuse, termen rounded, slightly oblique; silvery-white; costal edge black, from near base to apex with a series of attached irregular black marks at first very small but gradually increasing to near apex, where they reach  $\frac{1}{2}$  across wing; a transverse black spot in disc near termen; a narrow black streak along termen, tending to be interrupted into two or three separate marks on lower half; apical area

faintly yellowish-tinged: cilia white, on termen with a blackish basal line interrupted on lower portion, not reaching tornus. Hindwings yellowish-white; a moderate suffused dark grey streak along upper half of termen; cilia white, with a dark grey basal line opposite dark patch. Undersurface of all wings white, with black markings much as above.

N.G.: Biagi, Manibare R., (5000 feet; Meek); one specimen.

152. *C. sibyllina*, n.sp.

♂ 21 mm., ♀ 18 mm. Head and palpi orange. Thorax light yellowish, in ♀ white posteriorly. Abdomen ochreous-yellow, basal and two apical segments blackish (in ♀ broken). Forewings elongate, suboblong, costa without fold, towards base strongly, posteriorly slightly arched, apex obtuse, termen rounded, slightly oblique; silvery-white; costal edge black, very finely towards base, in ♂ posteriorly gradually much thickened and irregular-edged, in ♀ slender; some pale yellowish suffusion towards apex, and in ♀ on veins near termen; in ♂ a slender irregular black streak along termen preceded above middle by an irregular transverse black mark, in ♀ with a terminal series of black marks on veins connected on termen: cilia white, in ♂ with a blackish terminal line except towards tornus. Hindwings dark grey, darker towards apex; cilia white, with grey basal line. Undersurface of all wings dark grey, in ♂ hindwings mixed with whitish.

N.G.: Olgarra(Meek); two specimens. Very like the preceding, but immediately known by the different hindwings and undersurface.

27. *ZACORISCA*, n.g.

Head smooth-scaled. Palpi long, porrected, second joint thickened with dense appressed scales, terminal rather long, cylindrical, obtuse. Thorax without crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 closely approximated to 4 at base, 6 and 7 stalked.

153. *Z. holantha*, n.sp.

♀. 28 mm. Head, palpi, and thorax deep iridescent blue. Abdomen blue-blackish, apex ochreous-white suffused beneath with ochreous-yellow. Forewings elongate, rather narrow, costa moderately arched, apex obtuse, termen slightly rounded, almost vertical; deep iridescent blue; a rather narrow deep coppery-red terminal fascia: cilia purplish-coppery, above apex and below tornus deep blue. Hindwings blackish suffused with deep blue; cilia bright purple-blue with coppery reflections, with deep blue basal line.

N G.: Owgarra(Meek); one specimen.

28 *ATTERIA* Walk.

*Atteria* Walk., Cat. xxviii., 421(1863) ... type *strigicinctana*.

*Cerace* Walk., Cat. xxviii., 422(1863) ... type *stipitata*.

Head smooth-scaled. Antennæ in ♂ simple. Palpi rather long, porrected, second joint with smooth appressed scales, terminal moderately long, cylindrical. Thorax without crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3, 4, 5 approximated at base, 6 and 7 approximated towards base.

A genus of moderate extent, characteristic of S. Asia, the Malayan region, and S. America.

154. *A. thiasodes*, n.sp.

♂. 36 mm. Head, palpi, thorax, and abdomen deep blue, upper and lower margins of face whitish, anal tuft shining whitish-ochreous. Forewings sublong, rather dilated posteriorly, costa anteriorly moderately, posteriorly slightly arched, with moderately broad costal fold from base to near  $\frac{1}{2}$ , thence abruptly narrowed and continued to  $\frac{3}{4}$ , apex obtuse, termen hardly sinuate, almost vertical; orange; markings bright deep purple-blue; a short streak on base of costa; central fascia rather broad, oblique, extended on costa along narrow portion of fold, narrowed on dorsum, posterior edge angulated towards dorsum;

a triangular apical patch extending over  $\frac{1}{4}$  of costa and  $\frac{3}{4}$  of termen: cilia dark grey with deep blue subbasal shade, with an orange tornal patch. Hindwings blackish-purple; a deep orange terminal fascia, broad on costa and containing a blackish-purple apical blotch almost united with main area by blackish irroration, gradually narrowed downwards and hardly reaching tornus; cilia orange-ochreous, on dorsum and round apex dark grey.

Q. 36-40 mm. Head, palpi, thorax, and abdomen deep iridescent blue. Forewings formed as in ♂, without fold; orange; base very narrowly deep blue, shortly produced along costa; a large triangular deep purple apical patch, edge running from about middle of costa to tornus: cilia deep purple-blue round patch. Hindwings deep orange; a rounded purple-blackish apical blotch; cilia orange, on dorsum and round apex dark grey.

N.G.: Biagi, Mambare R. (5000 feet), Aroa R. (Meek), Fakfak; six specimens.

## 29. *TORTRIX* Linn.

*Tortrix* Linn., Syst. Nat. x., i., 496 (1758) ... type *viridana*.  
*Lozotenia* Steph., Cat. Brit. Ins. 169 (1829) ... type *forsterana*.

Antennæ in ♂ moderately ciliated. Palpi moderate or long, porrected, second joint dilated with rough scales above and beneath, terminal moderate. Thorax without crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 approximated towards base.

Largely represented in all regions; it is probable, however, that the Australian species form a homogeneous group developed locally. Many species possess the costal fold in ♂, but it is usually slight and narrow. The full generic synonymy is not given above.

### 155. *T. molesta*, n.sp.

♂ 16 mm., ♀ 17-19 mm. Head pale ochreous, between antennæ mixed with fuscous. Palpi whitish-ochreous sprinkled with fuscous. Antennal ciliations of ♂ minute. Thorax pale ochreous somewhat sprinkled with fuscous. Abdomen grey. Forewings

suboblong, in ♀ somewhat more elongate, costa anteriorly moderately arched, posteriorly nearly straight, costal fold in ♂ moderately broad, reaching to near middle, apex obtuse, termen nearly straight, rather oblique; whitish-ochreous more or less tinged with pale brownish, especially posteriorly; a very few small scattered dark fuscous strigulae on costa; central fascia very oblique, fuscous, rather narrow, somewhat marked with dark fuscous on costa, slightly dilated towards dorsum, anterior edge slightly concave below middle; an irregular rounded-triangular fuscous spot suffusedly irrorated with blackish close before middle of termen: cilia whitish-ochreous, at apex and tornus with fuscous bars mixed with black. Hindwings grey; cilia ochreous-whitish more or less tinged with grey, with grey subbasal shade.

Q.: Cairns(Dodd); from September to November, three specimens. Recognisable by the characteristic blotch before termen; the costal fold of ♂ is more strongly developed than in any other Australian species of the genus.

156. *T. calculata*, n.sp.

♂. 17 mm. Head, palpi, thorax, and abdomen whitish-ochreous; palpi long. Antennal ciliations 1. Forewings rather elongate-triangular, costa anteriorly moderately, posteriorly gently arched, costal fold narrow, reaching  $\frac{1}{3}$ , slightly dilated with scales towards middle, apex obtuse, termen distinctly sinuate, somewhat oblique; whitish-ochreous, with some small scattered grey strigulae, more numerous towards termen; base of costa slenderly blackish; six blackish dots in disc, viz., two indicating margin of basal patch, one in disc before middle, one towards dorsum beyond middle, one towards costa at  $\frac{2}{3}$ , and one in disc at  $\frac{1}{4}$ : cilia whitish-ochreous. Hindwings ochreous-whitish, faintly tinged with grey; cilia whitish, with faint grey subbasal streak.

Tasm.: Deloraine; in November, one specimen. Distinct from all Australian species, and nearly allied by the long palpi and other characters to the New Zealand *T. conditana* Walk. (*T. astrologana* Meyr.), with which I formerly identified it, but now



think it should be kept separate; *T. conditana* is much larger, 22-25 mm., very variable, in some forms very dissimilar, darker-coloured and fasciated; pale specimens in which the normal markings are obsolete certainly approximate, but the hindwings are always more or less spotted with grey.

157. *T. xyloides*, n.sp.

♂. 17-23 mm. Head and thorax whitish-ochreous, sometimes brownish-tinged, usually more or less wholly tinged or suffused with fuscous, thorax with a more or less marked dark fuscous transverse bar before middle. Palpi whitish-ochreous irrorated with fuscous or dark fuscous. Antennal ciliations  $1\frac{1}{2}$ . Abdomen pale greyish-ochreous mixed with grey. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, costal fold narrow, reaching to near middle, somewhat dilated with diminishing scales on posterior  $\frac{2}{3}$ , apex obtuse, termen almost straight, little oblique, rounded beneath; whitish-ochreous to brownish-ochreous, sometimes more or less irrorated with fuscous, on margins and towards termen strigulated with dark fuscous or blackish; basal patch brownish, with a few blackish strigulae, outer edge above middle with an irregular acute angular projection more or less edged with black strigulae; central fascia brownish or fuscous, oblique, upper half rather narrow, well-defined and more or less marked with black, with an acute angular projection on posterior edge above middle, lower half more or less suffused and indistinct, posteriorly confluent with an irregular patch extending over tornus and lower  $\frac{2}{3}$  of termen; costal patch brownish or fuscous, very elongate and narrow, extending along costa from middle to near apex, sometimes suffused with upper part of central fascia into a large triangular blotch, which in one specimen is dark fuscous: cilia whitish-ochreous, sometimes partially brownish-tinged, with an interrupted dark grey subbasal line. Hindwings light grey, spotted with darker, whitish along costa and sometimes somewhat suffused with whitish towards dorsum; cilia whitish, with somewhat interrupted dark grey subbasal line.

♀. 23-26 mm. Forewings more elongate than in ♂, fuscous or brownish; markings darker, formed as in ♂, but suffused and indistinct, sometimes almost wholly obsolete. Hindwings as in ♂, sometimes more whitish-tinged.

N.S.W.: Mount Victoria (3000 feet)—VIC.: Beaconsfield, Gisborne, Macedon, Lorne(Lyell)—TASM.: Launceston(Lea), Hobart (Turner)—W. AUST.: Albany; from August to February, fourteen specimens. Larva cylindrical, rather attenuated at extremities, with a few whitish hairs; bright yellowish-green; dorsal line dark green; head greenish-ochreous: feeds between joined leaves of *Pultenaea* sp., in September and October.

158. *T. ashworthana* Newm.

(*Tortrix ashworthana* Newm., Trans. Ent. Soc. Lond.(n.s.) iii., 286; *Teras responsana* Walk., Cat. xxviii., 297; *Pandemis secundana* ib. 310; *Cacæcia responsana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 500.)

Q.: Toowoomba (Turner)—N.S.W.: Glen Innes (3500 feet), Sydney—VIC.: Gisborne, Macedon, Melbourne(Lyell)—TASM.: Launceston, Deloraine, Hobart; from September to April. Larva amongst spun shoots of *Acacia decurrens*. I am now satisfied that the description of *T. ashworthana* can only be referred to this species; I do not know where the type-specimen is.

159. *T. postvittana* Walk.

(*Teras postvittana* Walk., Cat. xxviii., 297; *T. retractana* ib. 288; *T. scitulanana* ib. 298; *T. basialbana* ib. 299; *T. secretana* ib. 300; *Pandemis consociana* ib. 311; *Dichelia reversana* ib. 321; *D. fadana* ib. 321; *D. vicariana* Walk., Char. Het. 82; *Cacæcia postvittana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 502.)

Q.: Bundaberg, Brisbane, Stradbroke Island, Mount Tambourine(Turner)—N.S.W.: Glen Innes (3500 feet), Newcastle, Sydney, Orange, Kiama, Mount Kosciusko (4500 feet)—VIC.: Melbourne, Casterton—TASM.: Launceston, Deloraine, Hobart—S. AUST.: Mount Gambier, Mount Lofty, Port Lincoln—W. AUST.: Albany; from August to April. Also occurs in New Zealand

and Hawaiian Islands, but doubtless artificially introduced from Australia. Larva amongst spun leaves, flowers, and seeds of *Correa*, *Perseonia*, *Grevillea*, *Boronia*, etc., and has been bred from an apple.

160. *T. stipularis*, n.sp.

♂. 17 mm. Head, palpi, and thorax pale ochreous, palpi whitish beneath. Antennal ciliations 1. Abdomen whitish-grey. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, costal fold narrow, reaching  $\frac{2}{3}$ , triangularly dilated with scales towards its middle, apex obtuse, termen rounded, rather oblique; whitish-ochreous; markings rather light yellow-ochreous; costal fold marked with several blackish strigulae; basal patch faintly indicated, outer edge angulated above middle; central fascia oblique, towards costa moderate, posterior edge forming a strong angular dilation in middle, beneath this hardly defined posteriorly except on dorsum where it is broad, with traces of a faint streak rising from it parallel to termen; costal patch flattened-triangular, beginning at  $\frac{2}{3}$  but undefined posteriorly: cilia whitish-ochreous. Hindwings light grey; cilia whitish.

Vic.: Murtoa(Lyell); in February, one specimen. Type in Coll. Lyell.

161. *T. pyrrhula*, n.sp.

♂. 17 mm., ♀. 18 mm. Head whitish-ochreous, face with a ferruginous transverse bar. Palpi whitish-ochreous irrorated with ferruginous. Antennal ciliations in ♂ 1. Thorax whitish-ochreous irrorated or suffused with ferruginous-ochreous. Abdomen ochreous-whitish. Forewings suboblong, in ♂ rather dilated posteriorly, costa anteriorly moderately arched, posteriorly straight, in ♂ with very slight fold from base to  $\frac{2}{3}$ , somewhat enlarged with scales towards its middle, apex obtuse, termen in ♂ slightly rounded, in ♀ almost straight, little oblique, rounded beneath; whitish-ochreous tinged with yellowish, in ♂ sprinkled and on margins strigulated with ferruginous-ochreous, in ♀ suffused with ferruginous-ochreous and strigulated throughout.

with ferruginous, strigulae posteriorly irrorated with dark grey; markings in ♂ ferruginous-ochreous, in ♀ ferruginous sprinkled with dark grey; central fascia oblique, rather narrow and well-defined on upper third, rest broad, irregular, undefined; costal patch flattened-triangular, containing several costal dots of dark grey irroration: cilia in ♂ whitish-ochreous faintly barred with ferruginous-ochreous, in ♀ ferruginous-ochreous with base spotted with dark grey irroration. Hindwings ochreous-whitish indistinctly spotted with pale grey; cilia whitish.

S. Aust.: Port Lincoln; in November, two specimens.

162. *T. liadelpha*, n.sp.

♂. 18-20 mm. Head, palpi, and thorax brownish-ochreous. Antennal ciliations 1. Abdomen ochreous-whitish. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, costal fold very narrow, reaching  $\frac{2}{3}$ , somewhat expanded with scales towards its middle, apex obtuse, termen nearly straight, hardly oblique, rounded beneath; whitish-ochreous strewn throughout with yellow-ochreous or ferruginous-ochreous strigulae; costal fold ferruginous-ochreous; central fascia very oblique, reddish-fuscous mixed towards middle with ferruginous-ochreous, rather narrow, posterior edge slightly prominent above middle and abruptly dilated into a suffused blotch on dorsal third; costal patch flattened-triangular, reddish-fuscous: cilia whitish-ochreous. Hindwings ochreous-whitish, sometimes greyish-tinged on lower half, thinly spotted with light grey; cilia ochreous-whitish.

♀. 20 mm. Head, palpi, and thorax brownish-yellowish. Forewings as in ♂ but rather more elongate; rather deep yellow-ochreous, strigulated throughout with ferruginous-ochreous without markings: cilia ochreous-whitish. Hindwings as in ♂.

W. Aust.: Albany; in October, three specimens.

163. *T. caryotis*, n.sp.

♂. 21-22 mm. Head, palpi, and thorax whitish-ochreous more or less tinged with ferruginous-brownish. Antennal ciliations 1.

Abdomen light grey, anal tuft ochreous-whitish. Forewings sub-oblong, costa anteriorly moderately arched, posteriorly straight, costal fold very narrow, reaching middle, its posterior  $\frac{3}{4}$  somewhat expanded with gradually diminishing scales, apex obtuse, termen almost straight, slightly oblique; whitish-ochreous, more or less faintly and suffusedly strigulated with yellow-ochreous; basal half of costal fold suffused with reddish-fuscous; central fascia very oblique, reddish-fuscous more or less marked with purplish-fuscous and ferruginous, rather narrow, posterior edge suffused and indefinite on lower half; costal patch light reddish-fuscous, suffused, narrow, extending from  $\frac{3}{8}$  to apex; a few reddish-fuscous strigulae towards termen: cilia ochreous-whitish, with more or less indicated pale fuscous-reddish subbasal line. Hindwings light grey, indistinctly strigulated with darker; cilia whitish, with grey subbasal line.

Q. 24 mm. Head, palpi, and thorax reddish-brown. Forewings more elongate than in ♂, fulvous-ochreous, suffusedly strigulated with fuscous-reddish; edge of basal patch and of central fascia indicated on dorsum by dark reddish-fuscous strigulae: cilia ochreous-whitish, basal half light reddish-ochreous. Hindwings whitish-grey, becoming ochreous-whitish towards apex, faintly strigulated with grey; cilia whitish, with light grey subbasal line.

N.S.W.: Mount Kosciusko, 5000 feet—Vic.: Mount St. Bernard, 5000 feet (Lyell); in January and February, four specimens.

164. *T. tanyptera*, n.sp.

♂. 24-25 mm. Head, palpi, and thorax ferruginous. Antennal ciliations  $1\frac{1}{2}$ . Abdomen whitish-ochreous. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, costal fold narrow, reaching  $\frac{2}{3}$ , somewhat dilated with diminishing scales on posterior  $\frac{1}{3}$ , apex obtuse, termen straight, little oblique, rounded beneath; deep ochreous tinged with reddish, more or less strigulated suffusedly with bright ferruginous, especially anteriorly; a few very slight blackish strigulae on costal fold; central fascia little marked, ferruginous, sometimes mixed with

grey, narrow, oblique, almost obsolete in disc, rather broadly dilated posteriorly towards dorsum; sometimes a few scattered blackish scales towards termen: cilia whitish-ochreous tinged with yellow, basal half reddish-ochreous with two or three dark grey dots beneath apex, and a blackish-grey subbasal shade on tornus. Hindwings whitish, partially slightly tinged with grey, strigulated with pale grey, towards apex slightly tinged with yellowish: cilia whitish faintly tinged with yellowish, with a pale grey subbasal shade.

♀. 28-30 mm. Forewings more elongate than in ♂, similarly coloured, without markings, except some more or less indicated minute scattered fuscous-reddish strigulae: cilia deep ochreous more or less tinged with reddish, towards tips yellow-whitish, with a blackish-grey subbasal shade towards tornus and on upper part of termen, between these partially indicated by dots. Hindwings as in ♂, but more or less tinged with fulvous-ochreous towards apex.

VIC.: Melbourne(Kershaw), Gisborne(Lyell); in March and April, "beaten from *Acacia melanoxylon*"(Lyell); five specimens.

#### 165. *T. dotatana* Walk.

(*Teras dotatana* Walk., Cat. xxviii., 298.)

♀. 31 mm. Forewings brownish-ochreous, markings nearly obsolete, dorsum marked with dark fuscous. Hindwings grey-whitish spotted with grey.

TASM.: one specimen in British Museum. I cannot identify this with any species known to me, unless it is the other sex of the following.

#### 166. *T. ophiodesma* Low.

(*Cacasia ophiodesma* Low., Trans. Roy. Soc. S. Aust. 1902, 251.)

♂. 29 mm. Palpi long, with appressed scales. Antennal ciliations 2. Forewings with costal fold very slight, not reaching  $\frac{1}{2}$ , somewhat dilated with diminishing scales on its posterior  $\frac{3}{4}$ ; pale brownish-ochreous; an oblique dark fuscous mark in disc before  $\frac{1}{4}$ ; central fascia narrow, oblique, dark fuscous, sinuate outwards in middle, on lower half becoming ochreous-brownish,

less defined posteriorly, but suffused with dark fuscous anteriorly except towards dorsum; costal patch small, acute-triangular, brownish-ochreous, with angles suffused with dark fuscous; some minute dark fuscous strigulae towards termen: cilia pale brownish-ochreous. Hindwings ochreous-whitish, lower half slightly greyish-tinged except posteriorly, with a few pale grey spots in disc; cilia ochreous-whitish.

TASM.: Sheffield, in November; redescribed from type in Coll. Lyell. As suggested above, it is quite likely that this may be the ♂ of *T. dotatana*, in view of the correspondence in size and Tasmanian origin, but it seems better to await further evidence before uniting them. Veins 6 and 7 of hindwings appear to be very closely appressed towards base, but not truly stalked as stated by Lower.

167. *T. cetrata*, n.sp.

♂. 19 mm. Head, palpi, and thorax ferruginous-ochreous. Antennal ciliations 1. Abdomen ochreous-whitish. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, costal fold very narrow, reaching  $\frac{2}{3}$ , slightly expanded with scales on posterior half, apex obtuse, termen slightly rounded, somewhat oblique; ochreous-yellow, margins suffused with ferruginous-ochreous; angulated edge of basal patch faintly indicated with ferruginous-ochreous; markings reddish-fuscous suffused with rather dark fuscous; costal fascia broad, very oblique, narrowed towards costa, costal patch moderate, cloudy, these two suffused together with reddish-fuscous so as to form a very large subtriangular patch, leaving a suffused terminal fascia of groundcolour: cilia ochreous-yellow, paler towards tips. Hindwings grey-whitish; cilia ochreous-whitish.

TASM.: Deloraine; in November, one specimen.

168. *T. œnopa*, n.sp.

♂. 19 mm. Head, palpi, and thorax brownish-ochreous, suffusedly mixed with fuscous-reddish and ferruginous. Antennal ciliations 2. Abdomen pale greyish-ochreous. Forewings sub-

oblong, costa anteriorly moderately arched, posteriorly almost straight, costal fold narrow, reaching  $\frac{2}{3}$ , somewhat dilated with diminishing scales on posterior  $\frac{2}{3}$ , apex obtuse, termen rather obliquely rounded; fuscous-reddish, somewhat mixed with ferruginous, especially on anterior half; extreme edge of costal cilia whitish-ochreous on posterior  $\frac{2}{3}$ ; markings deeper, undefined, suffusedly mixed with rather dark grey; central fascia oblique, rather narrow on upper half, posterior edge expanded so as to form a subquadrate blotch on lower half; costal patch narrow, semioval, very indistinct: cilia light yellowish-ochreous, basal third brown-reddish. Hindwings ochreous-grey-whitish, lower half slightly greyer; cilia ochreous-whitish.

Vic.: Gisborne(Lyell); in March, one specimen. Type in Coll. Lyell. Near *T. cetrata*, but certainly distinct by the longer antennal ciliations.

169. *T. ocyptera*, n.sp.

♀. 22 mm. Head, palpi, and thorax reddish-ochreous tinged with grey. Abdomen light grey. Forewings suboblong, costa moderately arched, apex pointed, termen sinuate, oblique; reddish-ochreous, with small scattered blackish-grey dots and strigulae; extreme costal edge whitish-ochreous; a slender blackish-grey streak along dorsum from  $\frac{1}{4}$  to near middle; central fascia indicated by a small faint grey spot on costa at  $\frac{2}{3}$ , and a subtriangular dorsal blotch of grey irroration before tornus, with posterior angle marked by a triangular black dot: cilia pale whitish-ochreous, round apex and upper part of termen tinged with reddish, and at apex with grey. Hindwings pale greyish strigulated with grey, towards costa and apex suffused with whitish; cilia ochreous-white, towards tornus with a grey basal shade.

Vic.: Macedon(Lyell); in March, one specimen. Type in Coll. Lyell. The form of forewings is distinctive.

170. *T. arcaria*, n.sp.

♂. 21-23 mm. Head, palpi, and thorax varying from pale ochreous to fuscous, palpi long. Antennal ciliations  $\frac{2}{3}$ . Abdo-



men pale greyish-ochreous or grey. Forewings moderately elongate, posteriorly dilated, costa anteriorly moderately, posteriorly gently arched, costal fold very slight and rudimentary, hardly traceable except where somewhat enlarged with scales for a short distance before  $\frac{1}{2}$ , apex rectangular, termen faintly sinuate, somewhat oblique; varying from pale ochreous to fuscous; extremities of central fascia indicated by small obscure suffused darker spots; sometimes a few scattered blackish specks, especially towards termen: cilia concolorous. Hindwings ochreous-whitish, faintly greyish-tinged in disc and towards base, thinly spotted with light grey except towards apex; cilia ochreous-whitish.

♀ 23-24 mm. Forewings more elongate-oblong, not dilated; varying from pale greyish-ochreous to ochreous-fuscous; central fascia sometimes faintly darker, very narrow towards costa, moderately broad and irregular on lower  $\frac{2}{3}$ , with an irregular projection from near dorsum directed towards apex, sometimes quite obsolete. Hindwings as in ♂.

TASM.: Deloraine; in November and December; seven specimens.

171. *T. lycodes*, n.sp.

♂. 23 mm. Head and thorax ochreous mixed with ochreous-whitish, patagia mixed with dark ferruginous-fuscous. Palpi ochreous sprinkled with dark ferruginous-fuscous. Antennal ciliations 1. Abdomen greyish mixed with ochreous-whitish. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, costal fold very narrow, reaching  $\frac{2}{3}$ , slightly dilated with scales on posterior  $\frac{2}{3}$ , apex obtuse, termen distinctly sinuate, somewhat oblique; ferruginous-brown suffusedly mixed with pale ochreous, anteriorly sprinkled with fuscous; scattered dark fuscous strigulae along costa; basal patch indicated by undefined darker suffusion; central fascia very oblique, darker, on upper half very narrow and mixed with dark fuscous and ferruginous, with an angular projection on posterior edge above middle, on lower half very indistinct, extended as a patch of cloudy suffusion to tornus; costal patch ill-defined, flattened-triangular, extending from middle to near apex, mixed with dark fuscous,

and ferruginous: cilia pale brownish-ochreous mixed with grey on basal half. Hindwings light grey, towards costa with a few darker grey spots and somewhat whitish-tinged partially between these; cilia grey-whitish, with greyish subbasal shade.

Tasm.: Mount Wellington, 3500 feet; in December, one specimen.

172. *T. fabricata*, n.sp.

♂♀. 19 mm. Head and palpi brownish-ochreous. Antennal ciliations 1. Thorax ferruginous-ochreous. Abdomen grey, anal tuft grey-whitish. Forewings suboblong, costa anteriorly moderately arched, posteriorly straight, costal fold narrow, reaching to middle, its posterior  $\frac{2}{3}$  somewhat expanded with gradually diminishing scales, apex obtuse, termen straight, somewhat oblique, rounded beneath; light brownish-ochreous; markings yellowish-fusces mixed with light brown-reddish, dark-edged, well-defined; basal patch moderate, outer edge curved, oblique; central fascia oblique, moderate on upper half, twice as broad on lower half by sudden dilation of posterior margin; an apical patch edged by a sinuate line from before  $\frac{3}{4}$  of costa to termen above tornus: cilia pale brownish-ochreous, round apex tinged with brown-reddish. Hindwings in ♂ dark grey, cilia grey-whitish, with grey subbasal shade; in ♀ grey, broadly whitish towards costa, towards apex ochreous-tinged, cilia whitish.

Vic.: Lorne (Lyell); in February and March, two specimens.

173. *T. jugicolana* Meyr.

(*Cacacia jugicolana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 499.)

N.S.W.: Murrurundi (Raynor); in October. Larva on a species of *Compositae* resembling *Senecio*.

174. *T. sobriana* Walk.

(*Dichelia sobriana* Walk., Cat. xxviii., 322; *Cacacia mnemosynana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 504.)

♂♀. 16-18 mm. Sexes quite similar. Hindwings grey-whitish or whitish-grey, spotted with grey.

N.S.W.: Sydney, Bulli—VIC.: Gisborne, Macedon (Lyell), Warragul, Melbourne—TASM.: Hobart; from August to December, and from March to June.

175. *T. psapharana* Meyr.

(*Cacæcia psapharana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 174.)

TASM.: Launceston, Hobart; in December and January.

176. *T. peloxythana* Meyr.

(*Tortrix peloxythana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 514.)

N.S.W.: Murrurundi—VIC.: Castlemaine (Drake); in November.

177. *T. plastica*, n.sp.

♂. 18 mm. Head whitish, lower part of face tinged with fuscous. Palpi fuscous. Antennal ciliations 1. Thorax light fuscous. Abdomen light grey, sides and anal tuft whitish. Forewings suboblong, costa anteriorly moderately, posteriorly hardly arched, without fold, apex obtuse, termen almost straight, oblique; white; markings light fuscous mixed with ferruginous-brown and sprinkled with dark fuscous; a moderate basal patch, outer edge angulated in middle; space between this and central fascia sprinkled with pale ferruginous-brownish; central fascia broad, very oblique, somewhat narrowed towards costa, running to tornus, where it unites with a broad terminal fascia narrowed to a point at apex; costal patch flattened-triangular, extending from  $\frac{2}{3}$  to near apex: cilia light fuscous obscurely spotted with light ferruginous-brown, towards tips suffused with whitish. Hindwings whitish-grey; cilia whitish.

TASM.: Mount Wellington, 3000 feet; in February; one specimen.

178. *T. cerussata*, n.sp.

♂. 22-23 mm. Head whitish. Palpi light fuscous, more or less suffused with white above and beneath. Antennal ciliations  $1\frac{1}{2}$ . Thorax whitish, patagia suffused with brownish. Abdomen

grey, anal tuft whitish. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, without fold, apex obtuse, termen faintly sinuate, somewhat oblique; ochreous-whitish; markings variably suffused with grey or yellowish-grey, sometimes partially much marked with dark fuscous towards costa; basal patch well-marked on upper half, obsolete towards dorsum, outer edge obtusely angulated in middle; space between this and central fascia towards dorsum more or less strigulated with fuscous, grey, and pale yellowish; central fascia moderately broad, very oblique, well-marked, slightly narrower towards costa, posteriorly somewhat prominent above middle and usually coalescing at this point with costal patch; costal patch semioval, extending from middle of costa to near apex; sometimes a terminal band connecting this and central fascia, variable in development, sometimes reduced to a few strigulae and a transverse dark fuscous mark indicating its anterior margin: cilia ochreous-whitish, basal third fuscous or pale yellowish suffusedly spotted with fuscous. Hindwings whitish strigulated and spotted with grey, sometimes partially sprinkled with grey; cilia whitish, with interrupted fuscous subbasal line.

Vic.: Mount St. Bernard(5000 feet), Macedon(Lyell); in February and March, five specimens.

179. *T. spodota*, n.sp.

♂ 20 mm., ♀ 22-25 mm. Head, palpi, thorax, and abdomen pale whitish-ochreous irrorated or suffused with grey. Antennal ciliations of ♂  $\frac{3}{4}$ . Forewings suboblong, costa anteriorly strongly, posteriorly slightly arched, without fold, apex obtuse, termen in ♂ straight, nearly vertical, in ♀ slightly sinuate, somewhat oblique, rounded beneath; pale whitish-grey-ochreous, more or less suffusedly irrorated with grey; basal patch indicated by increased irroration, sometimes slightly marked with ochreous, very indefinite, outer edge angulated in middle; central fascia moderate, very oblique, becoming broader posteriorly on dorsal half, in ♂ light greyish suffused anteriorly and towards costa with ochreous, in ♀ more or less indicated by grey suffusion, very

indefinite; costal patch in ♂ triangular, greyish, partially marked with ochreous suffusion, in ♀ not traceable; some indefinite dark strigulation towards termen: cilia pale whitish-ochreous. Hindwings whitish, strigulated with grey, in ♂ slightly suffused with greyish: cilia whitish, with greyish subbasal line indicated towards tornus.

VIC.: Macedon (Lyell); in March, three specimens.

180. *T. scleropa*, n.sp.

♂. 21-22 mm. Head and thorax whitish-grey-ochreous, patagia tinged with light brownish-ochreous. Palpi whitish-ochreous sprinkled with grey. Antennal ciliations  $1\frac{1}{2}$ . Abdomen grey-whitish. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, without fold, apex obtuse, termen very faintly sinuate, somewhat oblique; very pale ochreous-yellowish sprinkled with white, before central fascia broadly suffused with whitish; central fascia moderate, very oblique; ferruginous-ochreous somewhat sprinkled with dark grey, anterior edge straight, well-defined, posterior suffused and indistinct, extended as a cloudy patch across tornus; costal patch slightly indicated by faint ferruginous-ochreous and greyish suffusion, and in one specimen whole posterior area beyond central fascia, suffusedly sprinkled with ferruginous-ochreous; a cloudy spot of grey irroration on middle of termen: cilia light grey, with darker subbasal shade. Hindwings and cilia whitish.

♀. 26 mm. Head and palpi light grey. Thorax light brownish-ochreous. Forewings more elongate than in ♂, brownish-ochreous slightly tinged with reddish; costal edge slenderly suffused with grey, extreme edge white; dorsum and termen rather broadly suffused with light grey; central fascia hardly darker except towards dorsum, where it is suffused with dark grey irroration: cilia grey. Hindwings whitish, faintly tinged with grey towards lower part of termen; cilia whitish.

VIC.: Mount St. Bernard, 5000 feet (Lyell); in February, three specimens.

181. *T. firmata*, n.sp.

♂. 21 mm. Head and thorax whitish-ochreous, patagia ochreous-brownish. Palpi whitish-ochreous sprinkled with fuscous. Antennal ciliations 1. Abdomen light grey. Forewings elongate, posteriorly dilated, costa anteriorly gently, posteriorly slightly arched, without fold, apex obtuse, termen slightly rounded, rather oblique; whitish-ochreous, strigulated with pale ochreous mixed with fuscous; basal patch small, ochreous-brownish, dotted with dark fuscous on costa, outer edge marked with dark fuscous, angulated in middle; central fascia rather broad, very oblique, rather dark fuscous, slightly narrowed towards costa, above tornus sending out a streak of fuscous suffusion near and parallel to lower half of termen; costal patch moderate, semioval, rather dark fuscous, with one or two pale strigulae on costa in middle: cilia whitish-ochreous, on basal half with traces of slight brownish bars near apex. Hindwings pale grey, towards apex whitish-tinged and somewhat darker-strigulated; cilia white.

Vic.: Birchip(Goudie); in September; one specimen. Type in Coll. Goudie.

182. *T. stigmatias*, n.sp.

♂. 17-20 mm. Head and thorax pale fuscous, sometimes tinged with reddish. Palpi pale fuscous, more or less sprinkled with blackish. Antennal ciliations  $\frac{3}{4}$ . Abdomen pale greyish-ochreous sprinkled with grey. Forewings elongate-triangular, costa gently arched, costal fold very slight and rudimentary, reaching to about middle, without dilation of scales, apex obtuse, termen faintly sinuate, hardly oblique; whitish-fuscous or light fuscous, more or less mixed with light brown-reddish, often with scattered small dark fuscous strigulae, especially on margins and posteriorly; central fascia oblique, on upper  $\frac{2}{3}$  narrow, brownish, edged with black and terminated beneath by a small blackish spot, usually interrupted beneath this, lower portion very indefinite, represented by a cloudy fuscous suffusion extending across tornus to lower half of termen and edged anteriorly by a

more or less indicated convex pale whitish-ochreous suffusion sometimes tinged with reddish: cilia whitish-fuscous, becoming ochreous-whitish towards tips, often more or less suffused with pale ferruginous. Hindwings grey-whitish, spotted with light grey; cilia grey-whitish, with grey subbasal shade.

Tas.: Deloraine—Vic.: Mount St. Bernard, 5000 feet (Lyell); in November, December, and February; nine specimens.

183. *T. psarodes*, n.sp.

♂♀. 23-26 mm. Head, palpi, and thorax whitish-fuscous more or less mixed with brownish and sometimes partially with ferruginous. Antennal ciliations in ♂ 1. Abdomen fuscous-whitish sprinkled with brown. Forewings suboblong, posteriorly dilated, costa towards base moderately, then hardly arched, in ♂ without fold, apex obtuse, termen sinuate, little oblique; brownish, slightly tinged with ferruginous, sometimes irrorated with fuscous, sometimes strigulated throughout with dark fuscous, in one ♂ slightly and in ♀ considerably whitish-mixed between strigulae; central fascia on upper half narrow, irregular, fuscous or only indicated by some blackish edging, on lower half wholly obsolete: cilia ochreous-whitish, with subbasal ferruginous line dotted with blackish, in Brisbane specimens suffused with ochreous-brownish. Hindwings grey-whitish or whitish-grey, strigulated with grey; cilia whitish or grey-whitish, with grey subbasal line.

Q.: Brisbane (Turner)—Vic.: Gisborne (Lyell), Sale (Miss M. Wise); a winter species, from June to August; four specimens.

184. *T. laganodes*, n.sp.

Q. 21-22 mm. Head light greyish-ochreous partially suffused with grey. Palpi pale greyish-ochreous irrorated with grey. Thorax reddish-fuscous more or less mixed with grey. Abdomen whitish-ochreous mixed with dark grey. Forewings suboblong, somewhat dilated posteriorly, costa anteriorly moderately arched, posteriorly straight, apex obtuse, termen sinuate, somewhat oblique; reddish-fuscous, strigulated with dark grey, with transverse series of deep red-brown strigulae; markings formed by dark

grey suffusion; central fascia moderate, oblique, sometimes narrowed towards costa, towards dorsum ill-marked or obsolete; costal patch moderate, semioval at about  $\frac{2}{3}$ ; more or less dark suffusion towards termen: cilia reddish-fuscous, more or less mixed with dark grey, extreme tips ochreous-whitish on termen. Hindwings grey, darker-strigulated; cilia ochreous-grey-whitish, with two grey shades.

VIC.: Gisborne, Beaconsfield(Lyell); in February and March, two specimens. Type in Coll. Lyell.

185. *T. piperata*, n.sp.

♂. 17 mm. Head and thorax fuscous. Palpi brownish, beneath suffused with dark fuscous. Antennal ciliations  $\frac{1}{2}$ . (Abdomen broken.) Forewings elongate, posteriorly dilated, costa gently arched, without fold, apex obtuse, termen slightly rounded, rather oblique; light fuscous, with small scattered ferruginous-brown strigulae, some on costa marked with black; a narrow irregular oblique ferruginous-brown streak marked with black from  $\frac{2}{3}$  of costa to above middle of disc, and a small similar spot beneath costa before  $\frac{3}{4}$ : cilia light fuscous. Hindwings bluish-hyaline, strewn with black specks; veins and a moderate terminal fascia grey; cilia light grey, with interrupted dark grey subbasal shade.

Q.: Brisbane(Turner); one specimen.

186. *T. ferrea*, n.sp.

♂. 18-20 mm. Head, palpi, and thorax varying from light to rather dark fuscous. Antennae with moderate ciliations(1) at apex of joints only. Abdomen grey. Forewings elongate, posteriorly dilated, costa gently arched, without fold, apex obtuse, termen nearly straight, rather oblique; light greyish-ochreous to brownish, strigulated throughout with fuscous or dark fuscous, these strigulae almost obsolete in the darkest specimens but very strong and numerous in the lightest; an oblique fuscous streak from costa at  $\frac{2}{3}$  to above middle of disc, dilated beneath, sometimes obsolete; costal patch rather small, triangular,



fuscous, indistinct or obsolete : cilia concolorous, outer half sometimes suffused with whitish. Hindwings grey, with traces of darker strigulæ; cilia light grey, with darker subbasal shade.

Vic.: Birchip(Goudie); in April, three specimens.

187. *T. pyrosemana* Meyr.

(*Cacæcia pyrosemana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 496.)

♂. 18-23 mm. Head, palpi, and thorax light fuscous sprinkled with darker. Antennal ciliations  $1\frac{1}{2}$ , at apex of joints. Abdomen grey. Forewings elongate, posteriorly dilated, costa anteriorly moderately, posteriorly slightly arched, without fold, apex obtuse, termen sinuate, somewhat oblique; ochreous-grey, strewn with very indistinct darker strigulæ; costa and dorsum shortly strigulated with dark fuscous; upper half of central fascia darker, ill-marked, oblique, terminated abruptly and somewhat black-marked beneath; costal patch hardly indicated : cilia ochreous-grey. Hindwings grey, faintly darker-strigulated; cilia light grey, with somewhat darker subbasal line.

N.S.W.: Sydney—Vic.: Wandin(Jarvis), Macedon, Gisborne (Lyell), Melbourne—S. Austr.: Mount Lofty; in November, February, May, and June. Described originally from the ♀ only, which sex is much more distinctly marked; the ♂ is very similar to *T. ferrea*, from which it appears to be truly distinct by the longer antennal ciliations, and sinuate termen of forewings.

188. *T. lythrodana* Meyr.

(*Cacæcia lythrodana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 497.)

N.S.W.: Blackheath, (3500 feet)—Vic.: Mount St. Bernard (5000 feet), Gisborne, Beaconsfield, Lorne(Lyell), Melbourne—Tas.: Mount Wellington—S. Austr.: Mount Lofty; from December to March.

189. *T. oriarcha*, n.sp.

♂. 20 mm. Head white. Palpi white, second joint externally dark fuscous except towards apex. Antennal ciliations 1.

Thorax white, shoulders and a posterior spot dark fuscous. Abdomen light grey, anal tuft suffused with whitish. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, costal fold very slight and narrow, reaching  $\frac{2}{5}$ , with triangular dilation of scales at  $\frac{1}{5}$ , apex obtuse, termen straight, rather oblique; dull white; markings dark fuscous; costal fold dark fuscous; a triangular blotch on base of dorsum, reaching  $\frac{2}{3}$  across wing; a straight oblique narrow fascia representing edge of basal patch, almost or quite interrupted near dorsum; central fascia nearly straight, narrow, oblique, posterior edge in middle with a narrow projection; a small spot on dorsum before tornus, and a large triangular spot above this, anteriorly connected with central fascia; a triangular blotch towards apex, its upper side connected with costa by three bars, of which first is sometimes prolonged almost to touch projection of central fascia, its lower angle resting on termen above tornus; some dark fuscous scales along termen: cilia white, on basal half with some narrow dark fuscous bars. Hindwings grey; cilia whitish, with indistinct grey subbasal shade.

Vic.: Mount St. Bernard, 5000 feet (Lyell); in February, amongst "Snow-gums" on the ridges. Type in Coll. Lyell.

190. *T. desmotana* Meyr.

(*Cacozia desmotana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 506.)

N.S.W.: Lawson (Lyell), Blackheath (3500 feet), Mount Kosciusko (4000 feet); from January to April.

191. *T. amænana* Walk.

(*Conchylis amænana* Walk., Cat. xxviii., 366; *C. semirectana* ib. xxx., 987; *C. galbana* Feld., Reis. Nov. pl. cxi., 29; *Tortrix amænana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 510.)

Hindwings sometimes suffused with dark fuscous (Gisborne form).

N.S.W.: Sydney, Blackheath (3500 feet), Mount Kosciusko (3500 feet)—Vic.: Mount St. Bernard (5000 feet), Gisborne

(Lyell)—S. Aust.: Victor Harbour(Guest); from November to March. Larva amongst spun shoots of *Monotoca scoparia*, usually three or four together in a good deal of dense web.

192. *T. subfurcatana* Walk.

(*Conchylis subfurcatana* Walk., Cat. xxviii., 368; *Tortrix subfurcatana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 511.)

N.S.W.: Moruya (Lyell), Richmond River, Sydney, Bulli, Bathurst, Mittagong, Mount Kosciusko(4300 feet)—Vic.: Gisborne(Lyell), Melbourne, Healesville—Tasm.: Launceston, Deloraine, George's Bay, Hobart—S. Aust.: Mount Graham, Mount Lofty; from September to March.

193. *T. paurozona* Low.

(*Tortrix paurozona* Low., Trans. Roy. Soc. S. Austr. 1902, 252.)

♂. 19 mm. Head, palpi, and thorax brownish mixed with whitish. Antennal ciliations  $1\frac{1}{2}$ . Forewings elongate, costa slightly arched, without fold, apex obtuse, termen straight, oblique; light brown; markings ochreous-whitish; a curved transverse streak from costa about  $\frac{1}{3}$ , reaching more than half across wing; a small costal mark before  $\frac{2}{3}$ ; a slender oblique fascia from dorsum at  $\frac{2}{3}$ , reaching  $\frac{2}{3}$  across wing; slender irregular streaks from dorsum at  $\frac{2}{3}$  and  $\frac{4}{5}$  meeting in disc beyond middle; three or four dots on posterior half of costa; a slender sinuate streak from beneath costa at  $\frac{4}{5}$  to tornus; a subtriangular spot near termen beneath apex; a dot at apex, and one on termen beneath middle. Hindwings dark fuscous suffusedly spotted with light brownish; on under surface these spots are suffused with whitish, and confluent in transverse series.

S. Aust.: Blackwood(Lower); in November(according to label, not October as stated by Lower). Described from type.

194. *T. aphrotis*, n.sp.

♂♀. 16-20 mm. Head white. Palpi white, tinged with grey externally. Antennal ciliations of ♂ 1. Thorax white irrorated with grey. Abdomen whitish-fuscous. Forewings suboblong,

costa anteriorly gently, posteriorly hardly arched, costal fold in ♂ narrow, reaching  $\frac{2}{3}$ , triangularly dilated with scales towards its middle, apex obtuse, termen nearly straight, rather oblique; pale greyish-ochreous, sometimes very finely speckled with dark fuscous, more or less suffusedly mixed with white, especially towards costa, which is sometimes wholly suffused with white; sometimes obscure grey or fuscous markings, consisting of some indefinite spots indicating basal patch, an oblique streak from costa before middle, becoming broader and continued longitudinally above middle to near termen, three or four small spots on posterior half of costa, and a blotch above tornus, but these are generally wholly obsolete (only represented in two specimens): cilia white, basal half more or less tinged with grey and finely speckled with dark fuscous. Hindwings light fuscous, becoming paler and whitish-tinged anteriorly; cilia white, sometimes with more or less indicated fuscous subbasal line.

W. Austr.: Carnarvon, Geraldton; in October and November, twelve specimens. Larva cylindrical, grey-whitish, greenish-tinged; dorsal slender, greyer; sometimes other lines faintly indicated; spots white; head marbled with brownish, or brown spotted with dark brown: feeds in spun-together shoots of a maritime shrub with grey-whitish leaves, not found in flower and therefore not identified, in October.

195. *T. paralia*, n.sp.

♂♀. 17-21 mm. Head whitish, sides of crown sometimes grey. Palpi grey, above and at base whitish. Antennal ciliations of ♂ 1. Thorax grey, sometimes mixed with white, posterior margin white. Abdomen whitish-ochreous. Forewings suboblong, costa anteriorly gently, posteriorly slightly arched, costal fold in ♂ narrow, reaching  $\frac{2}{3}$ , triangularly dilated with scales towards its middle, apex obtuse, termen straight, rather oblique; white, sometimes somewhat sprinkled with ochreous-grey or brownish towards dorsum and termen, seldom (in two specimens) suffused with brownish on dorsal half and towards termen; costal fold sometimes partially or wholly fuscous; markings yellow-ochreous,

sometimes mixed or partially suffused with fuscous or dark fuscous; basal patch more or less indicated by suffusion in disc and often an angulated series of three or four spots representing outer edge; an oblique streak from costa at  $\frac{2}{3}$ , angulated and continued above middle of disc to near termen, costal extremity and posterior portion sometimes obsolete; an irregular spot beneath angle of this, another above tornus, and a third towards dorsum between these, varying much in development, sometimes combined into a triangular blotch, sometimes partially or wholly obsolete, sometimes partially connected with longitudinal streak above it; five small spots on posterior half of costa, often wholly obsolete; sometimes a slender irregular streak along termen: cilia white, with a more or less developed interrupted dark fuscous subbasal line, sometimes wholly obsolete. Hindwings light fuscous, paler and whitish-tinged towards base; cilia white, sometimes with light fuscous subbasal line.

S. Austr.: Wallaroo, Port Lincoln; in November, eleven specimens. Somewhat broader-winged than *T. aphrotis*; ordinary forms of the two species are distinct enough, but some varieties approximate. Larva cylindrical, rather light green; dorsal and subdorsal narrow, dark green, conspicuous; head and second segment greenish-ochreous; feeds in spun-up shoots of *Aster axillaris*, in October and November.

196. *T. hydractis*, n.sp.

♂. 19 mm. Head, palpi, thorax, and abdomen rather dark fuscous, palpi whitish towards base beneath, apex of patagia white. Antennal ciliations 1. Forewings elongate, rather dilated posteriorly, costa gently arched, fold alight, narrow, reaching  $\frac{2}{3}$ , with triangular dilation of scales at  $\frac{1}{3}$ , apex obtuse, termen somewhat rounded, oblique; white; markings dark fuscous suffusedly mixed with brownish-ochreous; extreme base dark fuscous; two moderate fasciæ representing basal patch, outer angulated in middle; a transverse blotch on dorsum beyond this; a moderate oblique irregular-edged fascia from  $\frac{2}{3}$  of costa to  $\frac{3}{4}$  of dorsum; a small spot on costa and two or three irregular dots in

disc beyond this; an irregular fascia from  $\frac{3}{4}$  of costa to tornus, including a white dot on costa, connected posteriorly with a rounded blotch above middle; two small spots on costa before apex; an irregular streak along termen: cilia fuscous, basal half white barred with dark fuscous. Hindwings rather dark grey; cilia grey, with darker subbasal shade.

N.S.W.: Mount Kosciusko, 6000 feet; in January, one specimen.

197. *T. technitis*, n.sp.

♂♀. 22-24 mm. Head and thorax whitish more or less tinged or mixed with fuscous, shoulders and patagia except apex dark fuscous. Palpi dark fuscous, whitish above and towards base beneath. Antennal ciliations of ♂  $\frac{3}{4}$ . Abdomen grey. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, costal fold in ♂ slight, narrow, reaching  $\frac{2}{3}$ , with triangular dilation of scales at  $\frac{1}{2}$ , apex obtuse, termen almost straight, rather oblique; white; markings dark fuscous; costal fold dark fuscous; a median longitudinal streak from base, terminated in an oblique streak running from  $\frac{1}{4}$  of costa to beneath middle of disc, sometimes interrupted posteriorly; a subdorsal streak from base to beyond  $\frac{1}{2}$ ; a small dorsal spot beyond its apex, and some scattered fuscous scales round this; an oblique streak from  $\frac{3}{4}$  of costa to middle of disc, where it forms an angle often coalescing with apex of preceding streak from costa, and is continued above middle to near apex, posteriorly enlarged and forming a more or less marked projection downwards, and above coalescing more or less completely with three small inwardly oblique spots on posterior part of costa; a semioval spot on costa beyond middle; an oblique streak from  $\frac{3}{4}$  of dorsum to disc at  $\frac{3}{4}$ , thence angulated to tornus, variable and irregular in outline; a slender irregular streak along upper part of termen: cilia white, basal half suffusedly barred with dark fuscous, beneath apex and at tornus with grey patches. Hindwings grey, darker posteriorly; cilia grey-whitish, with grey subbasal shade.

N.S.W.: Bathurst(Stephenson)—Vic.: Lorne(Lyell); in March, ten specimens.

198. *T. cataractis*, n.sp.

♂. 20 mm. Head whitish, upper half of face fuscous. Palpi dark fuscous, whitish towards base beneath. Antennal ciliations  $\frac{2}{3}$ . Thorax fuscous, posteriorly whitish. Abdomen whitish-fuscous, with iridescent-silvery bands on margins of segments, anal tuft ochreous-whitish. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, costal fold narrow, reaching  $\frac{2}{3}$ , with triangular dilation of scales about its middle, apex obtuse, termen slightly sinuate, somewhat oblique; ochreous-whitish, with some scattered fuscous scales in disc; costal fold dark fuscous; a fuscous streak mixed with dark fuscous from base above middle to  $\frac{2}{3}$ , triangularly dilated posteriorly; a fuscous band occupying dorsal third throughout and continued along termen to apex, where it is terminated by a strong dark fuscous streak rising from costa at  $\frac{2}{3}$ , running obliquely to middle of disc, and thence angulated to apex; some dark fuscous scales scattered along upper margin of dorsal band, and a triangular dark fuscous spot resting on it above tornus: cilia whitish suffusedly mixed with fuscous (imperfect). Hindwings grey; cilia whitish, with grey subbasal shade.

Vic.: Mount St. Bernard, 5000 feet (Lyell); in February, one specimen. Type in Coll. Lyell.

199. *T. tessulatana* Meyr.

(*Cacocia tessulatana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 506.)

Vic.: Melbourne (Raynor). Still unique.

200. *T. serrata*, n.sp.

♀. 22 mm. Head whitish. Palpi fuscous, above and beneath whitish. Thorax fuscous, posterior edge white. Abdomen pale whitish-ochreous tinged with grey. Forewings suboblong, costa anteriorly gently, posteriorly slightly arched, apex obtuse, termen slightly rounded, rather oblique; rather light fuscous, somewhat sprinkled with whitish and dark fuscous; a rather broad white costal streak from base to  $\frac{2}{3}$ , narrowed posteriorly,

cut by two narrow angulated dark fuscous fasciæ representing basal patch but not reaching dorsum, and an oblique dark fuscous bar at  $\frac{2}{3}$ , and beyond this enclosing four triangular dark fuscous costal spots; a transverse dark fuscous mark in middle of disc, and a small dark fuscous spot on middle of dorsum; an irregular dark fuscous blotch above tornus, its upper angle preceded by a white dot: cilia whitish mixed with fuscous (imperfect). Hindwings fuscous, lighter anteriorly; cilia whitish with two fuscous shades.

Vic.: Nhill (Lyell); in June, one specimen. Type in Coll. Lyell.

201. *T. agrypna*, n.sp.

♂. 19-20 mm. Head, palpi, thorax, and abdomen light fuscous. Antennal ciliations 3. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, costal fold narrow, reaching middle, with triangular dilation of scales at  $\frac{1}{2}$ , apex obtuse, termen hardly sinuate, oblique; light fuscous more or less sprinkled with ferruginous and whitish; basal patch indicated by some irregular blackish-fuscous irroration, and a blackish-fuscous mark in disc representing its angle; central fascia on upper half fuscous irrorated with blackish, moderate, oblique, preceded and followed by more or less whitish suffusion towards costa, on lower half hardly indicated except by some blackish irroration towards dorsum before tornus; a small darker spot on costa before  $\frac{3}{4}$ ; two or three transverse series of small blackish strigulae in posterior part of wing: cilia pale whitish-ochreous, with a more or less marked brownish subbasal line. Hindwings light fuscous; cilia as in forewings.

VICTORIA: without further record; three specimens.

202. *T. eugramma* Low.

(*Tortrix eugramma* Low., Proc. Linn. Soc. N. S. Wales, 1899, 91.)

♂. 17-18 mm. Head and thorax fuscous mixed with whitish. Antennal ciliations 1½. Forewings suboblong, costa anteriorly gently arched, posteriorly straight, without fold, apex obtuse,



termen slightly rounded, rather oblique; fuscous mixed with dark fuscous, and sometimes partially with whitish; a moderately broad whitish band, partially tinged or sometimes much suffused with light fuscous, rising obliquely from costa at  $\frac{1}{4}$ , narrower here, anterior edge forming an acute angular projection in disc, angulated below middle and running to apex, lower edge concave beyond angulation; a whitish mark immediately beneath costa in middle, sometimes obsolete. Hindwings grey, indistinctly darker-strigulated.

VIC.: Sale (Miss M. Wise); from November to January. Re-described from type and two other specimens, all from Sale; I think Lower's record of Brighton may be an error based on *T. lathraea*.

203. *T. lathraea*, n.sp.

♂. 15-17 mm. Head, palpi, and thorax whitish-ochreous or greyish-ochreous, more or less sprinkled with dark fuscous. Abdomen greyish. Antennal ciliations 1. Forewings elongate, costa anteriorly gently arched, posteriorly nearly straight, without fold, apex obtuse, termen slightly rounded, oblique; whitish, partially tinged with pale ochreous-yellowish, on dorsal half and posteriorly more or less irrorated with light grey or dark fuscous; markings fuscous irrorated with dark fuscous, sometimes mixed with ferruginous or light yellowish; a moderate basal patch, outer edge angulated in middle; a flattened-triangular blotch extending along costa from  $\frac{1}{4}$  almost to apex, often containing an oblique whitish spot on middle of costa indicating the division between central fascia and costal patch; a blotch extending over tornus and termen, its edge running from  $\frac{2}{3}$  of dorsum to apex, triangularly prominent below middle: cilia pale greyish-ochreous or whitish-ochreous with brownish shade, often speckled with fuscous or dark fuscous. Hindwings grey, darker posteriorly, sometimes faintly strigulated with darker; cilia grey-whitish or pale greyish, with grey subbasal shade.

VIC.: Melbourne—TASM.: Deloraine; in November and December, eleven specimens.

204. *T. echinitis*, n.sp.

♂♀. 17-20 mm. Head and palpi pale brownish-ochreous, palpi whitish towards base beneath. Antennal ciliations of ♂  $1\frac{1}{2}$ . Thorax brownish-ochreous. Abdomen pale grey. Forewings elongate, costa gently arched, in ♂ without fold, apex obtuse, termen very faintly sinuate, oblique; brownish-ochreous mixed with light red-brownish, upper half of wing suffusedly mixed with whitish except on margins; markings ochreous-fuscous sprinkled with blackish-grey; an undefined patch in disc towards base, extended by grey suffusion almost to central fascia; central fascia narrow, sinuate, very oblique, not quite reaching tornus, edged anteriorly with whitish suffusion, sending a thicker branch from above middle gradually diminishing to costa before apex; from lower side of this branch near origin rises a streak, at first very narrow and running obliquely downwards, then thicker and bent up to termen beneath apex: cilia ochreous-whitish, basal third pale ochreous more or less spotted with pale red-brownish and dark grey. Hindwings light grey, faintly darker-spotted towards apex; cilia ochreous-whitish, with fine grey subbasal line.

S. AUST.: Port Lincoln; in November, two specimens.

205. *T. aulacana* Meyr.

(*Tortrix aulacana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 513; *T. asthenopsis* Low., Trans. Roy. Soc. S. Austr. 1902, 252.)

N.S.W.: Sydney—Vic.: Melbourne (Lower), Beaconsfield (Lyell), Healesville, Mount Macedon—TASM.: Deloraine—S. AUST.: Mount Lofty; from September to December, and in May. A variety occurs in which the markings are nearly obliterated by a general suffusion of the groundcolour.

206. *T. epichorda*, n.sp.

♂. 17 mm. Head and thorax light grey, crown sometimes whitish-tinged. Palpi ochreous-fuscous, whitish above. Antennal ciliations  $1\frac{1}{2}$ . Abdomen grey, apex whitish. Forewings elongate, costa moderately arched, without fold, apex obtuse-pointed,

termen very faintly sinuate, oblique; light fuscous largely suffused with whitish, with some scattered dark fuscous scales, tending to indicate transverse series of dots; costal edge dark fuscous towards base; a narrow somewhat upcurved fuscous streak, mixed with dark fuscous and tinged with ochreous, above middle from base to apex; a little-marked oblique bar of dark fuscous irroration from costa to this streak, indicating central fascia; a very small dark fuscous spot on dorsum at  $\frac{1}{3}$ ; a rhomboidal blotch of fuscous suffusion and dark fuscous irroration on tornus, extending over posterior third of dorsum and lower  $\frac{2}{3}$  of termen: cilia pale whitish-ochreous, at apex with a fuscous bar, and at tornus with a small dark fuscous basal spot. Hindwings grey, posteriorly darker spotted; cilia whitish, with grey subbasal shade.

VICTORIA: without further record; two specimens.

207. *T. eucela*, n.sp.

♂♀. 18 mm. Head, palpi, and thorax fuscous mixed with yellow-whitish, palpi rather long. Antennal ciliations of ♂ 1. Abdomen light grey. Forewings elongate, costa gently arched, in ♂ without fold, apex obtuse, termen obliquely rounded; fuscous, closely strewn throughout with yellow-grey-whitish scales, and sprinkled with blackish specks: cilia yellow-whitish, basal third light fuscous edged by a line of blackish irroration. Hindwings light grey; cilia grey-whitish, with grey basal shade.

TASM.: Mount Wellington, 3100 feet; in December, two specimens.

208. *T. telephanta*, n.sp.

♂. 18-19 mm. Head, palpi, and thorax fuscous. Antennal ciliations 1½. Abdomen grey, anal tuft light greyish-ochreous. Forewings elongate, costa gently arched, without fold, apex obtuse, termen almost straight, oblique; fuscous-grey, strewn with whitish scales, sometimes with small scattered blackish strigulae; markings darker, without whitish admixture, edges more or less marked with scattered blackish strigulae sometimes accompanied with some light brownish-ochreous scales; basal

patch with outer edge ill-defined, irregular, very oblique; central fascia moderate, irregular, very oblique, dilated on tornus; costal patch flattened-triangular, extending from beyond middle to near apex; an irregular blotch towards middle of termen, sometimes suffusedly confluent with one or other of preceding: cilia light fuscous, with darker basal shade. Hindwings rather light fuscous; cilia whitish-fuscous.

TASM.: Mount Wellington, 4100 feet; in December, three specimens.

209. *T. tasmaniana* Walk.

(*Conchylis tasmaniana* Walk., Cat. xxviii., 365; *Dipterina tasmaniana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 524.)

VIC.: Gisborne, Beaconsfield (Lyell), Melbourne (Raynor)—S. AUST.: Mount Lofty (Guest)—TASM. (Walker)—W. AUST.: Geraldton, York, Perth, Albany; from September to November, and January to March.

210. *T. nephaula*, n.sp.

♂. 13-15 mm. Head, palpi, thorax, and abdomen fuscous, palpi white beneath. Antennal ciliations 7. Forewings elongate, slightly dilated posteriorly, costa gently arched, without fold, apex obtuse, termen almost straight, rather oblique; fuscous-grey, more or less sprinkled or mixed with whitish, especially towards costa, and variably strewn with strigulae of black and reddish-brown scales; markings very indistinctly indicated, hardly darker, without whitish mixture; basal patch hardly defined, outer edge angulated in middle; central fascia moderate, oblique, only distinct towards costa: cilia pale grey, sometimes obscurely barred or partially suffused with whitish, with a dark grey sub-basal shade sometimes with some black and red-brownish scales. Hindwings fuscous, darker towards apex; cilia light grey with darker subbasal shade, tips whitish-suffused.

TASM.: Mount Wellington, 3000 feet; in December, four specimens.

211. *T. isochroa*, n.sp.

♂. 17-19 mm. Head and thorax greyish, sometimes suffusedly spotted with ferruginous. Palpi greyish. Antennal ciliations  $1\frac{1}{2}$ . Abdomen whitish-ochreous tinged with grey. Forewings suboblong, costa anteriorly moderately, posteriorly slightly arched, without fold, apex obtuse, termen slightly rounded, oblique; light fuscous suffusedly irrorated with white; markings formed by ferruginous irroration or suffusion, ill-defined and variable in development; basal patch very indefinite or almost obsolete; central fascia oblique, well-marked and rather narrow on upper half, sometimes marked with blackish irroration, on lower half considerably dilated posteriorly but sometimes little marked; a more or less marked triangular apical patch, extending to  $\frac{2}{3}$  of costa and middle of termen: cilia whitish, with grey subbasal line. Hindwings pale whitish-grey; cilia whitish, with faint greyish subbasal line.

W. AUST.: Waroona (Berthoud), York; in September and October, two specimens.

212. *T. liquidana* Meyr.

(*Cacacia liquidana* Mèyr., Proc. Linn. Soc. N. S. Wales, 1881, 505.)

Variable, with tendency to localisation of colour-varieties; forewings sometimes partially tinged or wholly suffused with ferruginous-ochreous; this suffusion begins towards dorsum and spreads more or less over whole wing; sometimes in ♀ the veins are indicated by lines of blackish specks. From Bathurst and Albany I have seen only the form with ferruginous-ochreous suffusion; at Gisborne and in Tasmania the grey and ochreous forms occur together, with intermediate varieties.

Q.: Stradbroke Island (Turner)—N.S.W.: Sydney (Lyell), Bathurst, Blackheath (3500 feet), Mount Kosciusko (4700 feet)—VIC.: Gisborne (Lyell), Melbourne—TAS.: Launceston, George's Bay, Mount Wellington—S. AUST.: Mount Lofty, Wirrabara, Port Lincoln—W. AUST.: Albany; from October to April.

213. *T. indigestana* Meyr.

(*Tortrix indigestana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 520.)

Vein 7 of forewings in ♂ sometimes runs to termen, but usually to apex, a somewhat unusual form of variation. A specimen in Mr. Lyell's collection has vein 4 of forewings absent on one side, though present as usual on the other.

N.S.W.: Sydney—VIC.: Gisborne(Lyell), Kewell(Hill)—TAS.: Hobart(Norman), George's Bay—S. AUST.: Port Lincoln—W. AUST.: Albany; from August to January. Also in New Zealand, but perhaps accidentally introduced. Larva amongst spun shoots and leaves of *Hibbertia linearis*, perhaps also other plants.

214. *T. haplodes*, n.sp.

♂. 14-16 mm. Head, palpi, thorax, and abdomen grey-whitish irrorated with grey. Antennal ciliations 1. Forewings sub-oblong, costa anteriorly moderately, posteriorly slightly arched, costal fold slight and very narrow, reaching about  $\frac{2}{3}$ , with triangular dilation of scales before  $\frac{1}{2}$ , apex obtuse, termen rounded, rather oblique; pale greyish-ochreous, tinged with whitish and faintly strigulated with greyish; central fascia darker, undefined, moderately broad, oblique, rather narrowed towards costa: cilia pale whitish-ochreous. Hindwings light grey; cilia ochreous-whitish, with faint greyish subbasal shade.

N.S.W.: Sydney; in November, two specimens.

215. *T. concordana* Meyr.

(*Tortrix concordana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 519.)

Q.: Stradbroke Island (Turner)—N.S.W.: Sydney, Blackheath (3500 feet), Bathurst—VIC.: Melbourne—S. AUST.: Mount Lofty (Guest); from July to November, and in March. Larva in spun shoots and amongst cylindrically joined leaves of *Hibbertia linearis* and *H. fasciculata*.

216. *T. standishana* Newm.

(*Tortrix standishana* Newm., Trans. Ent. Soc. Lond. iii.(n.s.), 286; Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 522.)

Q.: Duaringa (Barnard), Brisbane (Turner)—N.S.W.: Glen Innes (3500 feet), Blackheath (3500 feet), Sydney—S. AUST.: Mount Gambier, Mount Lofty—W. AUST.: Geraldton; from August to December, and in March.

217. *T. concolorana* Meyr.

(*Tortrix concolorana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 522.)

N.S.W.: Sydney—VIC.: Birchip (Goudie)—TASM.: George's Bay, Hobart; from September to January.

218. *T. scandalota*, n.sp.

♂. 17-18 mm. Head, palpi, and thorax yellow-ochreous. Antennal ciliations 1. Abdomen whitish-ochreous, dorsally suffused with grey. Forewings rather elongate, posteriorly considerably dilated, costa anteriorly moderately, posteriorly slightly arched, without fold, apex obtuse, termen almost straight, rather oblique; whitish-ochreous, with silvery reflections; markings yellow-ochreous marked with blackish on costa; basal patch more or less marked, outer edge somewhat bent and marked with a few dark grey scales in middle; one or two irregular striae between this and central fascia; central fascia very narrow, rather oblique, marked with several very small grey spots; a stria from  $\frac{2}{3}$  of costa to before tornus, marked with a few dark grey scales in middle; three more or less confluent striae from costa posteriorly: cilia whitish-ochreous. Hindwings light grey; cilia ochreous-whitish, with light grey subbasal line.

VIC.: Mount St. Bernard, 5000 feet (Lyell); in February, two specimens.

219. *T. immersana* Walk.

(*Pædisca immersana* Walk., Cat. xxviii., 390; *Tortrix trygodana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 515, 535.)

N.S.W.: Sydney—VIC.: Sale—W. AUST.: Waroona(Berthoud); in September and October.

220. *T. divulsana* Walk.

(*Conchylis divulsana* Walk., Cat. xxviii., 364; *Tortrix glaphyrana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 516.)

Q.: Duaringa (Barnard), Brisbane, Stanthorpe, Warwick (Turner), Toowoomba—N.S.W.: Katoomba(Lyell), Newcastle, Sydney, Bathurst, Shoalhaven, Cooma—VIC.: Gisborne(Lyell), Castlemaine(Drake), Wandin(Jarvis), Melbourne—TASM.: Deloraine, Hobart—S. AUST.: Mount Gambier(Guest), Mount Lofty, Port Lincoln—W. AUST.: Bridgetown (Berthoud), Geraldton, Perth, Albany; from October to April. Larva feeds on lucerne and is an injurious pest(Lyell); probably also on allied plants.

30. MERITASTIS, n.g.

Antennæ in ♂ moderately ciliated. Palpi rather short, slender, ascending, with appressed scales, terminal joint short. Thorax without crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3, 4, 5 approximated at base, 6 and 7 closely approximated towards base.

Apparently a modification of *Epichorista*.

221. *M. umbrosa*, n.sp.

♂. 17-18 mm. Head, palpi, thorax, and abdomen dark grey, shoulders sometimes mixed with ferruginous-brown. Antennal ciliations 1. Forewings suboblong, costa anteriorly gently, posteriorly slightly arched, without fold, apex obtuse, termen almost straight, rather oblique; rather dark grey; about nine irregular indistinct partially interrupted darker strise mixed with black and ferruginous-brown scales: cilia ochreous-whitish tinged with brownish, basal half grey mixed with ferruginous-brownish. Hindwings rather dark grey; cilia light grey, with darker sub-basal shade. Hindwings beneath suffused with grey-whitish and strigulated with dark grey.

VIC.: Macedon(Lyell); in November, two specimens.



## 31. EPICHORISTA Meyr.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal joint short. Thorax without crest. Forewings with 3 from angle, 7 and 8 separate, 7 to termen. Hindwings with 3 and 4 approximated at base, 5 rather approximated to 4, 6 and 7 closely approximated towards base or stalked.

I have characterised this genus in the Annals of the Transvaal Museum, and also in the Transactions of the New Zealand Institute for the current year, but as neither is yet published, I cannot give exact reference. The genus contains seven described species from New Zealand, and several from South Africa, but is not known elsewhere.

222. *E. serena*, n.sp.

♂. 16-17 mm. Head and thorax light yellow-ochreous. Palpi yellowish-ochreous, externally tinged with fuscous towards middle. Antennæ dark grey, ciliations nearly 3. Abdomen grey. Forewings elongate, posteriorly dilated, costa gently arched, without fold, apex obtuse, termen almost straight, oblique; ochreous-yellowish or pale yellowish, slightly sprinkled with grey; costa and dorsum usually shortly strigulated with dark fuscous irroration; numerous irregular cloudy pale silvery-grey or silvery grey-whitish striae or series of small spots; basal patch and extremities of central fascia sometimes indicated by grey suffusion: cilia ochreous-yellowish or pale yellowish, paler towards tips, at apex with a greyish spot. Hindwings with 6 and 7 stalked; grey; cilia whitish-grey, with grey subbasal line.

TASM.: Mount Wellington, 2100-2300 feet; in December, three specimens.

223. *E. smenodes*, n.sp.

♂. 16 mm. Head, palpi, and thorax yellow-ochreous, palpi somewhat sprinkled with dark fuscous. Antennæ dark grey, ciliations nearly 2. Abdomen grey. Forewings elongate, pos-

teriorly dilated, costa gently arched, without fold, apex obtuse, termen straight, oblique; pale ochreous-yellowish, posterior half mixed with ferruginous and suffusedly irrorated with dark grey; costa and dorsum shortly strigulated with dark fuscous; numerous irregular cloudy pale leaden-grey transverse striae: cilia white, basal third ferruginous mixed with dark grey, sharply limited. Hindwings with 6 and 7 stalked; grey; cilia grey-whitish, with grey subbasal line.

TASM.: Hobart; in December, one specimen. Nearly allied to the preceding, but distinguishable by the shorter antennal cilia-tions, and quite different cilia of forewings.

224. *E. camacinana* Meyr.

(*Proselena camacinana* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 172.)

TASM.: Mount Wellington (2000 feet), Deloraine; from November to February.

225. *E. illucida*, n.sp.

♀. 17-18 mm. Head and thorax pale fuscous, shoulders suffused with whitish. Palpi ochreous-whitish, suffused with light grey towards apex. Abdomen whitish-ochreous dorsally suffused with pale grey. Forewings suboblong, costa anteriorly moderately arched, posteriorly nearly straight, apex obtuse, termen sinuate, vertical; whitish-ochreous, obliquely and suffusedly striated with shining prismatic silvery-whitish, and more or less mixed with pale brown-reddish; costa marked with oblique ferruginous-brown strigulae, from which rise about five very oblique striae of black specks mixed with red-brownish, and a red-brown atria just before termen; a large undefined semioval patch extending along dorsum from base to near tornus and reaching half across wing, formed of light red-brownish suffusion variably mixed with darker red-brown and more or less strigulated with blackish irroration: cilia ferruginous-brown with a grey line, on tornus suffused with whitish-ochreous. Hindwings with 6 and 7 approximated; grey, costal area broadly ochreous-

whitish or pale yellowish, apical area suffused and strigulated with grey; cilia ochreous-whitish sometimes tinged with yellowish, round lower part of termen and dorsum more or less tinged with grey.

Q.: Mount Tambourine, Eumundi (Turner); in October and November, two specimens. A peculiar species, superficially resembling a *Homona*, but structurally very different.

226. *E. iodes*, n.sp.

♂ Q. 17-20 mm. Head and thorax grey-whitish, patagia sprinkled with ferruginous-ochreous. Palpi whitish, externally tinged with ochreous and irrorated with grey. Antennal ciliations of ♂ 1½. Abdomen whitish. Forewings elongate-oblong, posteriorly hardly dilated, costa towards base gently arched, posteriorly straight, without fold, apex obtuse, termen rounded, somewhat oblique; ochreous-whitish, more or less irrorated on costal half with ferruginous and on dorsal half with grey; basal patch represented by some undefined spots of ferruginous suffusion, and a ferruginous streak along costa to central fascia; central fascia very undefined, very oblique, formed of grey irroration; suffused with ferruginous towards costa and on an elongate patch beneath middle and a preternal spot; costal patch flattened-triangular, ferruginous, extending from near middle to near apex; an irregular transverse ferruginous blotch before termen from above middle to near tornus, tending to unite with submedian patch of central fascia; cilia whitish, basal half irrorated with ferruginous. Hindwing light grey, towards base somewhat whitish-tinged; cilia white, with partial grey subbasal line.

S. Austr.: Glenelg (Guest), Wallaroo, on coast sandhills; in November, four specimens.

227. *E. petrochroa* Low.

(*Cupua petrochroa* Low., Trans. Roy. Soc. S. Austr., 1908, 115.)

♂ Q. 15-22 mm. Antennal ciliations of ♂ 1. Forewings with costa gently arched towards base, posteriorly nearly straight,

without fold, termen rounded, somewhat oblique; whitish-ochreous, strigulated throughout with yellow-ochreous; some short fuscous strigulae on costa anteriorly; markings yellow-ochreous, sometimes tinged with brownish in disc; basal patch more or less marked, outer edge angulated above middle; central fascia rather narrow, very oblique, anterior edge projecting angularly above middle, beneath this slightly convex, posterior edge suffused; two more or less indicated dots at angles of cell; anterior portion of costal patch indicated by a curved mark; sometimes a more or less marked slender transverse streak in middle towards termen; cilia whitish-ochreous. Hindwings with 6 and 7 short-stalked; ochreous-whitish, sometimes faintly greyish-tinged posteriorly; cilia whitish.

N.S.W.: Broken Hill (Lower)—Vic: Birchip (Goulie)—S. Aust.: Wallaroo; in October, November, April, and May. Larva amongst loosely spun leaves of *Zygophyllum fruticulosum*, in October. This and the next two species are closely similar, and careful attention must be given to the details of descriptions.

228. *E. therina*, n sp.

♂♀. 15-16 mm. Head and thorax whitish-ochreous, patagia tinged with brownish. Palpi whitish-ochreous, externally tinged with brownish. Antennal ciliations of ♂  $\frac{3}{4}$ . Abdomen whitish-ochreous mixed with pale grey. Forewings elongate-oblong, costa anteriorly moderately arched, posteriorly nearly straight, without fold, apex obtuse, termen sinuate, oblique; light ochreous-yellowish; several minute dark fuscous strigulae on anterior half of costa; markings yellow-ochreous tinged with grey; sometimes a dot on fold at  $\frac{2}{3}$ ; central fascia moderate, very oblique, considerably narrowed towards costa, anterior edge slightly convex on lower half, marked with a black dot above middle, posterior edge prominent in disc and near tornus sending an oblique streak parallel with termen to above middle, marked with two or three black scales in disc; costal patch semi-oval, on costal edge forming three small dark fuscous spots separated by whitish-ochreous interspaces; another small dark fuscous spot on costa before apex;

a slender streak along termen: cilia whitish-ochreous, at apex somewhat mixed with fuscous. Hindwings with 6 and 7 short-stalked; light grey, darker towards apex; cilia whitish, with grey subbasal line.

TASM.: Deloraine; in November and December, four specimens.

229. *E. microstictis*, n.sp.

♂♀. 17-18 mm. Head and thorax whitish-ochreous, patagia tinged with brownish. Palpi whitish-ochreous, externally slightly tinged with brownish. Antennal ciliations of ♂ 1. Abdomen light grey, anal tuft ochreous-whitish. Forewings elongate-oblong, costa anteriorly gently arched, posteriorly nearly straight, without fold, apex obtuse, termen slightly sinuate, rather oblique; whitish-ochreous, tinged with yellowish, posteriorly with traces of darker dots or strigulae sometimes tinged with grey; two or three minute black dots on costa; a small ochreous spot marked with a minute black dot on submedian fold at  $\frac{2}{3}$ ; markings yellow-ochreous, sometimes slightly tinged with grey; central fascia slender, very oblique, anterior edge straight, marked with several minute black dots from above middle to near dorsum, posterior edge more or less irregular; a slender streak from tornus parallel to termen reaching middle, marked with several minute black dots; costal patch indicated by a short slender curved streak from costa marked with three minute black dots, and two or three blackish dots on costa beyond this; a very slender streak along central portion of termen, marked with a few black scales: cilia whitish-ochreous. Hindwings with 6 and 7 short-stalked; pale grey, posteriorly obscurely darker-strigulated; cilia whitish, with grey subbasal line.

N.S.W.: Mount Kosciusko, 5000 feet; in January, two specimens.

32. *AROTROPHORA* Meyr.

*Arotrophora* Meyr., Proc. Linn. Soc. N. S. Wales

1881, 528 ... .. type *arcuatalis*.

Antennae in ♂ dentate, fasciculate-ciliated. Palpi long or very long, porrected, second joint with gradually diminishing:

rough projecting scales above and beneath, terminal joint moderate. Thorax without or sometimes with slight crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 approximated at base, 6 and 7 closely approximated towards base.

Closely allied to *Tortrix*, of which it may be regarded as an endemic development. In addition to the characters of antennæ and palpi, it is marked as a natural group by its geographical restriction and probably also by being almost exclusively attached to plants of the Natural Order *Proteaceæ*, especially *Banksia*, with which I have always found them associated. The species are usually inactive, and seldom removed from their foodplant. None possess a costal fold.

230. *A. cosmoplaca* Low.

(*Arotrophora cosmoplaca* Low., Trans. Roy. Soc. S. Austr., 1903, 219.)

W. Austr.: Waroona (Berthoud), Perth, Geraldton; in October and November. A handsome and very distinct species.

231. *A. ochraceella* Walk.

(*Crampus ochraceellus* Walk., Cat. xxvii., 177; *Arotrophora ochraceella* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 175.)

N.S.W.: Newcastle, Sydney; in October. Attached to *Banksia serrata*, the larva probably feeding in the cones.

232. *A. charistis*, n.sp.

♂. 16-17 mm. Head and thorax white. Palpi 3½, ochreous, white above and towards base beneath. Antennæ strongly dentate. Abdomen whitish. Forewings elongate, rather narrow towards base, posteriorly dilated, costa slightly arched, apex obtuse, termen straight, rather oblique; white, with some small fine scattered pale ochreous-yellowish strigulae, especially towards margins, where they are touched with grey; a deep yellow streak from before ¼ of costa to beneath middle of disc, thence angulated upwards to end of cell, narrowed towards extremities; a straight

deep yellow streak, suffused with ferruginous-orange posteriorly from apex to tornus: cilia white. Hindwings whitish; cilia white.

Q.: Cooktown(Meek); two specimens.

233. *A. arcuatalis* Walk.

(*Scopula arcuatalis* Walk., Cat. xxxiv., 1474; *Crambus submarginellus* ib. xxxv., 1760; *Eromene transciissella* ib. 1762; *Arotrophora arcuatalis* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 530.)

N.S.W.: Sydney, Blackheath (3500 feet)—VIC.: Gisborne, Dimboola (Lyell)—TASM.: Launceston—S. AUST.: Mount Lofty, Mount Gambier, Wirrabara—W. AUST.: Bridgetown(Berthoud), Perth, York, Geraldton; from October to December and February to April. Larva in flower-cones of *Banksia serrata*, in July and August, and again in January.

234. *A. chionaula*, n.sp.

♂♀. 15-16 mm. Head white. Palpi  $4\frac{1}{2}$ , fuscous; white above and towards base beneath. Antennæ in ♂ shortly dentate. Thorax white, shoulders more or less suffused with fuscous. Abdomen ochreous-whitish tinged with grey. Forewings elongate, posteriorly rather dilated, costa anteriorly gently arched, posteriorly straight, apex round-pointed, termen faintly sinuate, oblique; whitish densely irrorated with dark fuscous, appearing dark grey; sometimes an undefined streak of ferruginous-red suffusion beneath costa anteriorly; a suffused irregular white longitudinal median streak from base to end of cell, thence bent up to costa before apex; a more or less marked spot of ochreous-yellowish suffusion beneath this in middle of disc; sometimes some ferruginous-red scales at apex: cilia whitish, with three fuscous shades tipped with dark fuscous. Hindwings whitish-grey or light grey, becoming darker grey towards apex; cilia whitish, with two indistinct grey shades.

W. AUST.: Perth; in November, nine specimens.

235. *A. canthelias*, n.sp.

♀. 21 mm. Head and thorax light fuscous irrorated with whitish. Palpi 5, ochreous irrorated with grey and beneath with whitish. Abdomen light greyish-ochreous. Forewings elongate, posteriorly considerably dilated, costa gently arched, apex obtuse, termen somewhat rounded, slightly curved, rather oblique; ferruginous-ochreous irrorated with dark grey, dorsal third suffused with grey and sprinkled with whitish; trapezoidal blotch of dark grey suffusion extending on costa from near base to beyond  $\frac{3}{4}$ , discal edge much shorter and broadly suffused with bright ferruginous, posteriorly reaching end of cell, posterior side edged by a fascia of white suffusion sprinkled with grey strigulae and extended to dorsum: cilia white suffusedly barred with grey. Hindwings pale grey, faintly ochreous-tinged; cilia grey-whitish.

N.S.W.: Mittagong; in March, one specimen, beaten from *Banksia spinulosa*.

236. *A. pirastis*, n.sp.

♀. 16 mm. Head and thorax pale fuscous mixed with whitish. Palpi 6, fuscous, darker beneath with base whitish, sprinkled with whitish above. Abdomen light fuscous. Forewings elongate, posteriorly slightly dilated, costa anteriorly moderately, posteriorly slightly arched, apex obtuse, termen straight, oblique; fuscous, irregularly strigulated with ferruginous and sprinkled with whitish; an undefined triangular patch of darker fuscous suffusion extending on costa from  $\frac{1}{2}$  to apex, with angle resting on end of cell; a small ferruginous spot with some black scales beneath submedian fold at  $\frac{1}{2}$ , another beneath lower angle of cell, and a short linear transverse mark on upper angle; some scattered blackish scales on dorsum and termen: cilia light fuscous, with two darker shades. Hindwings and cilia pale fuscous.

TASM.: Deloraine; in November, one specimen.

237. *A. castanea*, n.sp.

♂. 20 mm. Head whitish. Palpi 6, dark grey, mixed externally with ferruginous-ochreous, above and beneath sprinkled



with whitish. Antennæ shortly dentate, thickened on central third. Thorax whitish, shoulders suffused with ferruginous-brownish. Abdomen pale grey. Forewings elongate, posteriorly rather dilated, costa anteriorly gently, posteriorly slightly arched, apex obtuse, termen almost straight, oblique; ferruginous-brownish, much mixed with grey; dorsal third mixed with whitish, with a few black specks; an elongate-triangular patch of dark grey suffusion extending along costa from  $\frac{1}{4}$  to apex, mixed with deep ferruginous-brown, undefined anteriorly, darkest posteriorly, with angle resting on upper angle of cell; posterior margin of cell marked with bright ferruginous-brown, with a few black specks: cilia light grey, with two dark grey shades. Hindwings light grey, darker-strigulated; cilia whitish-grey, with faint darker subbasal line.

S. AUST.: Mount Lofty(?); one specimen. Type in Coll. Lower.

238. *A. xylopterana* Meyr.

(*Arctrophora xylopterana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 529.)

N.S.W.: Sydney, Mittagong; in August and March. Larva in a silken tube among leaves of *Lomatia silaifolia*; probably also on *Banksia*, as the imago has been beaten from it.

239. *A. anemarcha* Low.

(*Tortrix anemarcha* Low., Trans. Roy. Soc. S. Austr. 1902, 236.)

♂♀. 24-30 mm. Head and thorax light brownish-ochreous. Palpi 6. Antennæ in ♂ strongly dentate. Forewings elongate-oblong, posteriorly rather dilated, costa gently arched, apex obtuse, termen nearly straight, rather oblique; pale greyish or pale ochreous, reticulated throughout with ferruginous-brown or ferruginous-ochreous: cilia ochreous, irrorated or suffused with ferruginous-brownish. Hindwings whitish-grey, obscurely strigulated with grey; cilia whitish.

N.S.W.: Sydney—TASM.: Launceston—W. AUST.: Perth; in October and November, beaten from *Banksia marginata*. Probably rather common but very retired in habit. In Lower's

original description the size given, 20 mm., is a clerical error for 30 mm.

240. *A. ammodes*, n.sp.

♂♀. 20-22 mm. Head, palpi, and thorax ochreous-brown, palpi 5, tinged with ferruginous. Antennæ in ♂ strongly dentate. Abdomen grey. Forewings elongate, posteriorly dilated, costa moderately arched, apex obtuse, termen almost straight, rather oblique; ferruginous-brown; a rather broad streak of grey suffusion with a few blackish specks extending along dorsum from near base to a large similar subtriangular tornal patch, which limits cell posteriorly and reaches its upper angle; a minute blackish dot above lower angle of cell: cilia rather dark grey. Hindwings grey, obscurely darker-strigulated; cilia whitish-grey, with grey subbasal shade.

VIC.: Dandenong, Beaconsfield (Lyell); in November and March, two specimens.

241. *A. pertinax*, n.sp.

♀. 22 mm. Head and thorax light fuscous. Palpi 5, light fuscous sprinkled with darker. Abdomen whitish-fuscous. Forewings suboblong, costa moderately arched, apex obtuse, termen almost straight, oblique; light fuscous, strewn throughout with ferruginous-fuscous strigulae sprinkled with black specks; a slight darker suffusion indicating a basal patch with irregularly angulated outer edge, and an angulated central fascia confluent with a large triangular costal patch extending nearly to apex: cilia light fuscous mixed with darker (imperfect). Hindwings pale grey, indistinctly darker-strigulated; cilia whitish-grey.

VIC.: Healesville; in November, one specimen.

242. *A. salebrata*, n.sp.

♂♀. 15-16 mm. Head and thorax light fuscous irrorated with whitish. Palpi 3½-4, fuscous irrorated with whitish. Antennæ in ♂ rather strongly dentate. Abdomen light greyish-ochreous. Forewings elongate, posteriorly somewhat dilated, costa gently arched, apex obtuse, termen hardly rounded, oblique; light

fuscous, more or less distinctly strigulated with dark fuscous, especially on margins; an undefined trapezoidal patch of dark fuscous suffusion extending on costa from near base to  $\frac{3}{4}$ , discal edge much shorter and terminated posteriorly by a white transverse-linear mark on end of cell; some whitish irroration beyond this patch, especially towards costa; two patches of dark fuscous irroration towards termen more or less distinctly outlined with dark fuscous and sometimes partially edged with whitish, upper subtriangular, lower larger, somewhat reniform: cilia pale fuscous irrorated with whitish, with three interrupted darker fuscous shades indicating bars. Hindwings uniform pale fuscous; cilia whitish-fuscous, towards tips whitish.

Vic.: Gisborne(Lyell); in February and March, two specimens.

243. *A. humerella* Walk.

(*Crambus humerellus* Walk., Cat. xxxv., 1758; *Tortrix centurionana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 518.)

N.S.W.: Sydney—Vic.: Beaconsfield(Lyell)—S. Austr.: Mount Lofty, in July and August.

244. *A. hemerana* Meyr.

(*Arotrophora hemerana* Meyr., Proc. Linn. Soc. N. S. Wales, 1882, 176.)

Female with forewings narrower than in ♂, termen more oblique.

Vic.: Mount St. Bernard, 5000 feet (Lyell)—Tasm.: Mount Wellington, 3000 feet; in February.

245. *A. confusana* Walk.

(*Pædisca confusana* Walk., Cat. xxviii., 381; *Arotrophora confusana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 532.)

N.S.W.: Sydney; in October, March, and April, amongst *Banksia*.

246. *A. lividana* Meyr.

(*Arotrophora lividana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 531.)

Q.: Brisbane—N.S.W.: Sydney, Bulli, Mittagong, Bathurst—  
VIC.: Gisborne, Dimboola(Lyell)—TASM.: Launceston, George's  
Bay—S. AUST.: Mount Lofty—W. AUST.: Albany, Perth, York;  
in October, November, January, March, and April. The species  
varies a good deal, even in form of wing; some specimens may be  
said to have the costa moderately arched, others slightly; the  
Bathurst example is the largest (♀, 16 mm.), with the longest  
palpi, and has the termen of forewings sinuate, but I am unable  
to regard it as distinct; no two specimens are quite alike. I  
was, however, accustomed to meet with the species commonly,  
and never had any doubt of its identity. I mention these par-  
ticulars because they contribute to the difficulty of what follows.

I have bred this species from the larva under circumstances so  
singular that I cannot interpret them to my own satisfaction,  
and therefore give them at length in the hope that local workers  
will make investigations on the subject. I found some extra-  
ordinary larvæ, of which I made the following description: Larva  
apodal, slender, cylindrical, head small, semicircular, segments  
2-4 (especially 2) much swollen, all incisions well-marked, anal  
segment pointed and with short spines towards apex; positions  
of all legs indicated by feeble sucking-bases; ordinary spiracles  
absent, but two dorsal spots on each of segments 2-4 greatly  
enlarged and furnished with a longitudinal slit; rather dark  
fuscous, reddish-tinged; head and back of segment 2 blackish,  
segments 2 and 3 with a reddish dorsal line; large dorsal spots  
of segments 2-4 light ochreous; all other spots obsoletely repre-  
sented by slight depressions; anal segment blackish towards  
apex: mines a long rather broad gallery down leaves of a large  
coarse sedge-like plant growing in dry bush at Botany Bay, in  
August; the last three segments of body are held at a right angle  
and used as a lever for motion within the gallery; pupation out-  
side the mine, amongst refuse. From these larvæ I bred one  
rather small and pale female specimen, with somewhat less  
ferruginous suffusion than any other example possessed, fore-  
wings hardly dilated posteriorly, costa slightly arched: I have a  
captured male from Sydney which hardly differs from it, and

shows the normal structure of the antennæ, which is characteristic, the dentations being very strong. There are three possible interpretations of this recorded observation, viz.:

(1.) The larval habit recorded is that of *A. lividana*: against this may be set the repeatedly observed fact that the imago is attached to *Banksia*, from which I have habitually beaten it, this being recorded in my diary, and that the allied species are all equally attached to *Banksia*, implying community of habit; whilst the other bred species of the genus are known to feed on *Banksia* and its allies, and their larvæ are quite normal in structure. The larva described above is altogether singular, and I know nothing approaching it.

(2.) The larva described is that of some other species unknown, and the larva of *A. lividana* was introduced accidentally with the foodplant without being observed; as only one was bred, this is conceivable, but it does not seem at all likely. I always kept each kind of larva in a small separate receptacle.

(3.) Two species are confused under the name of *A. lividana*, one feeding as described, the other being a *Banksia*-feeder; this explanation derives some support from the variation in the specimens, but involves the improbable supposition that two species so closely allied as to be practically indistinguishable have larvæ so divergent in structure.

For myself, I can only say of the above explanations that all three seem to me nearly equally improbable. I fully expected some specially interesting insect from these curious larvæ, and was much disappointed to rear a common Tortricid of which I had regarded the habits as practically already known. If obliged to choose one of the three explanations, I should select the second.

247. *A. atimana* Meyr.

(*Arotrophora atimana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 533.)

Q.: Brisbane (Turner)—N.S.W.: Sydney; in August, September, and January. A small thoracic crest is present in this species.

248. *A. anaptis*, n.sp.

♂♀. 16-18 mm. Head, palpi, and thorax fuscous finely sprinkled with whitish, palpi  $3\frac{1}{2}$ . Antennæ in ♂ moderately dentate. Abdomen ochreous-grey. Forewings elongate, posteriorly dilated, costa moderately arched, apex obtuse, termen straight, oblique; fuscous, finely sprinkled with whitish, towards margins strigulated with darker; a trapezoidal darker fuscous blotch on dorsum before middle, its upper edge forming anteriorly a spot of deep ferruginous and blackish scales reaching fold; a large subtriangular suffused darker fuscous blotch extending on costa from before  $\frac{1}{4}$  to beyond middle and reaching fold, variably mixed with deep ferruginous and blackish, darkest posteriorly, and containing a lighter patch on costa; beyond this is sometimes a broad fascia of stronger whitish irroration, in which are two black dots on angles of cell; two or three somewhat darker spots on costa posteriorly, and an irregular transverse streak before termen: cilia fuscous, slightly whitish-sprinkled, with darker sub-basal line. Hindwings grey; cilia pale grey.

N.S.W.: Blackheath (3500 feet), Mount Kosciuszko (4700 feet)  
—TASM.: George's Bay; in January and February, seven specimens.

33. *EULIA* Hb.

*Eulia* Hb., Verz. 392 (1826) ... type *ministrana*.  
*Lophoderus* Stph., Cat. Brit. Ins. 184 (1829) ... type *ministrana*.  
*Gobaea* Walk., Cat. xxxv., 1805 (1866) ... type *copiosana*.

Antennæ in ♂ moderately ciliated. Palpi moderate, porrected, second joint dilated with rough scales above and beneath, terminal moderate. Thorax with well-developed crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 approximated towards base.

A genus of some extent, but mainly European and American, especially developed in South America.

249. *E. copiosana* Walk.

(*Gobaea copiosana* Walk., Cat. xxxv., 1805; *Tortrix ceramicana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 512; *T. argyraspis* Low., Proc. Linn. Soc. N. S. Wales, 1900, 410.)

Q.: Brisbane; in December and May. This species seems to be distinctly related to the South American forms of the genus,

## 34. HARMOLOGA Meyr.

*Harmologa* Meyr., Trans. N. Zeal. Inst. 1882, 44... type *oblongana*.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal moderate. Thorax with crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3, 4, 5 approximated towards base, 6 and 7 stalked or approximated towards base.

Besides the following, there are about eight New Zealand species.

250. *H. miserana* Walk.

(*Teras miserana* Walk., Cat. xxviii., 301; *T. canigerana* ib. 301; *T. absumptana* ib. xxxv., 1780; *Cacoccia miserana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 498.)

Q.: Cairns (Dodd), Nelson (Lyell), Toowoomba—N.S.W.: Newcastle, Sydney, Wollongong; throughout the year. Also occurs in Java and Assam. Larva rather slender, cylindrical, with scattered whitish hairs; grey-whitish, posteriorly ochreous-tinged; two brownish-ochreous spots placed longitudinally on back of each segment; lateral line moderately broad, reddish-fuscous; head dark fuscous; segment 2 whitish, posteriorly tinged with ochreous, posterior angles suffusedly blackish: feeds between joined leaves of *Ficus benjamina* and another *Ficus* not identified, rolling up a corner for shelter, in August (and doubtless most of the year); pupation in same position.

251. *H. crobylota*, n.sp.

♂. 25 mm. Head white, between antennæ with a long projecting tuft of hairs suffused with light grey. Palpi white, with

a longitudinal dark grey streak on side, above with expanded white hairs. Antennal ciliations  $\frac{1}{2}$ . Thorax white sprinkled with grey. Abdomen pale greyish-ochraceous. Forewings sub-oblong, costa anteriorly moderately, posteriorly slightly arched, with moderately broad fold reaching from base to middle, apex rounded-obtuse, termen rounded, rather oblique; white, somewhat sprinkled with pale greyish, and strewn throughout with dark grey strigulae partially mixed with black and ferruginous; the black markings appear to indicate edge of basal patch, anterior edge of central fascia, and triangular costal patch, but these are hardly traceable except towards costa; a rather large dorsal patch of grey suffusion before termen: cilia white, on basal half with indications of undefined dark grey bars. Hindwings thinly scaled, whitish, towards apex suffused with light grey; cilia grey-whitish.

N. GUINEA: Fakfak; one specimen. Allied to *H. miserana*, but larger, with hindwings more whitish, and specially characterised by the peculiar frontal tuft.

### 35. *CNEPHASIA* Curt.

*Cnephasia* Curt., Brit. Ent. iii., 100(1826) ... type *pascuana*.  
*Sciaphila* Tr., Schmett. Eur. vii., 233(1826) ... type *wahlbomiana*.  
*Dipterina* Meyr., Proc. Linn. Soc. N. S. Wales,  
 1881, 523... .. type *imbriferana*.

Antennae in ♂ moderately or strongly ciliated. Palpi moderate or long, porrected, second joint with projecting scales above and beneath, terminal moderate. Thorax sometimes with small crest. Forewings with 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 approximated to 4, 6 and 7 stalked.

A genus of considerable extent and nearly cosmopolitan.

### 352. *C. periorma*, n.sp.

♂♀. 13-16 mm. Head, palpi, antennae, thorax, and abdomen dark fuscous; palpi with a longitudinal orange-yellow band on second joint, base whitish; antennae in ♂ dentate on apical half,



ciliations 2. Forewings elongate-triangular, costa gently arched, apex obtuse, termen rather bowed, little oblique; dark fuscous, irregularly marked and striated with darker; basal patch containing two or three blue-metallic striæ, its edge marked by a strong curved dark fuscous stria, followed by two pairs of subconfluent blue-metallic striæ; disc beyond this strewn with scattered pale bluish hairscales; a dark bronzy-fuscous streak from  $\frac{3}{4}$  of costa to termen above tornus, preceded by a pair of lighter striæ becoming gradually violet-blue-metallic downwards, and followed by a violet-blue-metallic stria, confluent beneath with a similar submarginal stria; a light ochreous streak runs round apex, sometimes nearly obsolete: cilia fuscous, with interrupted dark fuscous subbasal shade. Hindwings dark fuscous irregularly striated with darker, base of scales pale; along lower half of termen a suffused blackish patch, irregularly marked on marginal portion with violet-golden-metallic and on inner portion with light ochreous-yellowish; cilia fuscous, with blackish-fuscous subbasal shade, mixed with pale golden-metallic on terminal patch.

Q.: Cairns(Dodd); in October and April, six specimens. A very curious species, but *C. catenata* forms a clear connecting link with normal forms.

253. *C. catenata*, n.sp.

♂. 15 mm. Head and thorax fuscous. Palpi rather long, fuscous, second joint with a longitudinal ochreous-orange stripe. Antennæ dentate, ciliations 1. Abdomen dark fuscous, anal tuft yellowish. Forewings moderate, posteriorly dilated, costa moderately arched, apex obtuse, termen bowed, somewhat oblique; rather dark purplish-fuscous, with scattered dark ferruginous-brown strigulae; costa strigulated with dark ferruginous-brown, costal edge whitish between these; edge of basal patch dark ferruginous-brown, obtusely angulated above and in middle; central fascia very narrow, dark ferruginous-brown, angulated and twice interrupted in disc, dorsal section somewhat broader; a dark ferruginous-brown streak from  $\frac{3}{4}$  of costa to middle of termen; apical area beyond this striated with leaden-metallic and

ferruginous-brown : cilia light ochreous with two purplish-fuscous shades sprinkled with dark fuscous. Hindwings ochreous-whitish, posteriorly strigulated with grey, apex suffused with grey; some dark purplish-grey suffusion on dorsum terminated by a dark fuscous trapezoidal spot on tornus; cilia whitish with a faint rosy tinge, with grey subbasal line becoming dark grey on tornus.

N.S.W.: Roseville, Sydney (Lyell); in April, one specimen. Type in Coll. Lyell.

254. *C. orthias*, n.sp.

♂. 20 mm. Head, palpi, and thorax dark grey, thoracic crest blackish. Antennal ciliations 4. Abdomen light grey. Forewings elongate, moderate, rather dilated posteriorly, costa moderately arched, apex obtuse, termen almost straight, rather oblique; light grey, somewhat sprinkled with whitish, and strigulated throughout with black accompanied by a few ferruginous scales; basal patch rather small, darker, somewhat mixed with ferruginous-brown, edged by a strong straight direct black streak attenuated to a line on costa, and somewhat bent just beneath it; central fascia rather narrow, straight, rather oblique, darker, edged with irregular blackish striae; apical area beyond an irregular stria from  $\frac{2}{3}$  of costa to tornus suffused with darker grey, on costa marked with four small blackish-grey spots: cilia light grey mixed with darker, with blackish-grey subbasal shade. Hindwings light grey, suffusedly spotted with darker; cilia grey-whitish, with two grey shades.

Vic.: Castlemaine (Drake); in October, one specimen. Type in Coll. Lyell.

255. *C. lenæa*, n.sp.

♂. 18 mm. Head and palpi grey sprinkled with darker and tinged with reddish. Antennal ciliations 4. Thorax dark grey mixed with ferruginous. Abdomen pale grey. Forewings elongate-triangular, costa moderately arched, apex obtuse, termen faintly sinuate, rather oblique; light grey much suffused with whitish, with slight scattered strigulae of black and ferruginous scales; some small darker spots along costa; basal patch short,

suffused with ferruginous-reddish and strongly edged with black, edge angulated above middle and indented below middle; central fascia very narrow, straight, rather oblique, suffused with ferruginous-reddish and edged with black, posterior edge rather rounded-prominent above middle; indistinct darker spots towards tornus and middle of termen: cilia grey mixed with whitish and light brown-reddish, basal third spotted with darker grey. Hindwings whitish-grey coarsely strigulated with grey; cilia grey-whitish, with two grey shades.

♀. Forewings more elongate and less dilated than in ♂; dark grey, suffused throughout with ferruginous-reddish, and strigulated with deep ferruginous mixed with black, with scattered grey-whitish scales; markings as in ♂, but hardly traceable except posterior edge of central fascia which is defined with deep ferruginous edged with some grey-whitish scales, rounded prominence above middle well-marked: cilia grey much suffused with ferruginous-reddish, with two undefined blackish lines, tips ochreous-whitish.

W. Aust.: Waroona (Berthoud); in September, two specimens — Vic.: Castlemaine (Drake); in October, one specimen. Types in Coll. Lyell.

256. *C. phosphora*, n.sp.

♂♀. 18-20 mm. Head, palpi, and thorax grey or dark grey, sometimes slightly reddish-tinged. Antennal ciliations in ♂ 4. Abdomen grey. Forewings rather elongate, moderate, dilated posteriorly, costa moderately arched, apex obtuse, termen nearly straight, oblique; grey or dark grey, somewhat sprinkled with whitish and ferruginous-reddish, in ♀ darker and more reddish-tinged, with scattered dark strigæ of blackish irroration with some reddish scales, especially on dorsum and towards termen; basal patch and central fascia dark grey, often sprinkled with ferruginous-reddish, margined with cloudy blackish lines, edge of basal patch curved or rather bent above middle, central fascia moderate, oblique; four or five small dark grey spots on posterior half of costa: cilia greyish, sometimes reddish-sprinkled, with

two dark grey lines, basal third sometimes barred with darker. Hindwings clear whitish, with a few scattered grey spots; a rather narrow suffused grey terminal fascia, broader at apex; cilia whitish, with dark grey subbasal line and pale grey post-median shade.

TASM.: Mount Wellington, 3100 feet; in November and December, nine specimens. Nearly allied to *C. rupicolana*, but immediately distinguished by the quite different hindwings.

257. *C. rupicolana* Meyr.

(*Dipterina rupicolana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 526; *D. refuana* ib. 525.)

N.S.W.: Murrurundi, Sydney, Blackheath (3500 feet)—VIC.: Gisborne (Lyll), Wandin (Jarvis), Melbourne—S. AUSTR.: Mount Lofty (Guest); from August to October. The form *refuana* is merely a dark variety.

258. *C. rigida*, n.sp.

♂. 17 mm. Head dark brown with a whitish central stripe. Palpi dark fuscous, apex of second joint brown-whitish. Antennal ciliations 1. Thorax blackish marked with white, patagia white with a black subbasal bar and becoming dark brown at tips. Abdomen pale ochreous-yellowish. Forewings elongate, posteriorly dilated, costa slightly arched, apex obtuse, termen hardly rounded, rather oblique; ochreous-white; markings dark leaden-grey edged with strong black stripe of raised scales; basal patch marked with three black stripes, with some whitish suffusion between first two, outer edge irregular, excised below middle, followed by two or three blackish strigulae towards dorsum; a black dot on costa before central fascia, and two beyond it; central fascia narrow, almost straight, direct, followed by a transverse-linear black mark in disc; a narrow fascia from  $\frac{1}{2}$  BL costa to tornus; some black dots round apex and termen irregularly connected with this and each other: cilia whitish-ochreous, with two dark grey partially interrupted shades. Hindwings grey,

darker posteriorly; cilia whitish-ochreous, with broad grey sub-basal shade.

W. Aust.: Waroona(Berthoud); in September, one specimen. Type in Coll. Lyell.

259. *C. cedilis*, n.sp.

♂. 13 mm. Head and thorax brown sprinkled with whitish and blackish, thoracic crest well developed. Palpi rather long, brown sprinkled with black, tip white. Antennal ciliations 2. Abdomen dark grey. Forewings elongate-oblong, costa anteriorly gently, posteriorly hardly arched, apex obtuse, termen almost straight, rather oblique; whitish, with a few scattered brownish strigulae, on costa with a few blackish dots; markings dark ferruginous-brown mixed with black; basal patch moderate, outer edge almost rectangularly angulated in middle; central fascia moderately broad, straight, very oblique; costal patch moderate, semicircular; a triangular blotch extending along upper  $\frac{2}{3}$  of termen, its apex reaching to disc beneath posterior edge of costal patch: cilia light greyish, with a ferruginous-brown subbasal shade mixed with blackish. Hindwings dark grey, lighter towards base; cilia whitish-grey, with dark grey subbasal shade.

Vic.: Lorne(Lyell); in February, one specimen. Type in Coll. Lyell.

260. *C. tribolana* Meyr.

(*Dipterina tribolana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 525; *D. gnophodryas* Low., Trans. Roy. Soc. S. Austr., 1902, 254.)

Vic.: Macedon(Raynor)—Tasm.: Mount Wellington; in November and December.

261. *C. crotala*, n.sp.

♂. 13-14 mm. Head, palpi, and thorax fuscous mixed with white. Antennal ciliations 4. Abdomen light fuscous. Forewings elongate, posteriorly somewhat dilated, costa gently arched, apex obtuse, termen nearly straight, rather strongly

oblique; light fuscous more or less mixed with whitish, with scattered spots and strigulae of dark fuscous irroration; markings somewhat darker fuscous, irregularly marked with strigulae of blackish irroration accompanied by some whitish-ochreous scales; basal patch moderate, outer edge rather acutely angulated above middle; central fascia moderately broad, acutely angulated above middle, becoming obsolete on dorsal third; costal patch moderate, rounded; a very undefined terminal fascia becoming obsolete towards tornus: cilia light fuscous, with dark fuscous subbasal line. Hindwings rather dark grey; cilia light greyish, with dark fuscous subbasal line.

TASM.: Deloraine; in November and December, three specimens.

262. *C. stereodes*, n.sp.

♂♀. 15-17 mm. Head, palpi, and thorax fuscous mixed with dark fuscous. Antennal ciliations in ♂  $2\frac{1}{2}$ . Abdomen dark grey. Forewings elongate, slightly dilated posteriorly, costagently arched, apex obtuse, termen slightly rounded, rather oblique; fuscous or dark fuscous, sometimes more or less sprinkled with ferruginous, irregularly strigulated with blackish; costal edge sometimes whitish; markings darker, much mixed with blackish, especially on margins; edge of basal patch curved or rather bent in middle; dorsal  $\frac{2}{3}$  between this and central fascia more or less mixed with whitish; central fascia moderately broad, narrowed towards costa, little oblique; a very undefined fascia from  $\frac{2}{3}$  of costa to tornus: cilia grey, with interrupted blackish subbasal shade. Hindwings dark fuscous, somewhat lighter anteriorly; cilia fuscous, with darker subbasal shade.

VIC.: Gisborne(Lyell), Wandin(Jarvis), Macedon, Healesville.—TASM.: Deloraine, Mount Wellington; from October to December, nine specimens.

263. *C. mermiera*, n.sp.

♂♀. 15-18 mm. Head and thorax fuscous mixed or sometimes suffused with whitish. Palpi fuscous irrorated with dark fuscous, mixed with white towards apex of joints. Antennae in ♂ dentate

on apical half, ciliations  $1\frac{1}{2}$  diminishing to 1. Abdomen light fuscous mixed with whitish. Forewings elongate, posteriorly dilated, costa gently arched, apex obtuse, termen almost straight, oblique; whitish, variably and irregularly marbled with fuscous or sometimes mostly suffused with fuscous, more or less mixed irregularly with whitish-ochreous or pale yellowish and sometimes in disc and towards dorsum with ferruginous; markings rather dark fuscous marked with blackish; basal patch moderate, outer edge obtusely angulated in middle; central fascia rather broad, oblique, on lower half sometimes obsolete except posterior edge; four or five subquadrate spots on posterior half of costa, two of them sometimes confluent into a blotch; a variable irregular blotch before middle of termen: cilia whitish barred with fuscous, with a fuscous subbasal shade. Hindwings in ♂ whitish suffusedly striated with light grey, in the Gisborne specimen light grey striated with darker, in ♀ grey; cilia whitish, with grey subbasal line.

VIC.: Lorne (3 ♂s), Gisborne (1 ♂) (Lyell)—TASM.: Mount Wellington, 3100 feet (3 ♀s); from December to March. This is a variable species, and the fact that the sexes are from different localities introduces a slight element of uncertainty, but there seems no reason to dispute their identity.

264. *S. sulfurosa*, n.sp,

♂♀. 9-12 mm. Head and thorax pale whitish-yellow, shoulders narrowly dark grey. Palpi dark reddish-grey, towards apex white. Antennal ciliations of ♂ 1. Abdomen light grey, anal tuft whitish. Forewings elongate, rather narrow, costa slightly arched, apex obtuse, termen obliquely rounded; pale whitish-yellow; a black dot on base of costa; a small triangular black spot on costa at  $\frac{1}{2}$ , whence a transverse direct line of black specks runs to dorsum, accompanied with two tufts of yellower scales; central fascia and costal patch united to form a rather broad dark grey black-mixed fascia beyond middle, considerably expanded towards costa; anterior edge marked with a blackish stria forming a triangular black spot on costa and accompanied by

some raised scales, posterior edge also marked with raised scales in disc; a line of black specks from costa at  $\frac{1}{5}$  to termen above tornus: cilia grey-whitish, towards base sprinkled with black specks. Hindwings grey, in ♂ thinly scaled and subhyaline anteriorly; cilia pale greyish.

Q.: Stradbroke Island (Turner)—N.S.W.: Sydney—Vic.: Melbourne (Drake); from September to February, seven specimens.

265. *C. ochroptila*, n.sp.

♂. 16 mm. Head and thorax fuscous-whitish. Palpi whitish-ochreous somewhat mixed with fuscous. Antennal ciliations minute. Abdomen pale greyish-ochreous sprinkled with fuscous. Forewings elongate, posteriorly dilated, costa slightly arched, apex obtuse, termen slightly rounded, somewhat oblique; light brown irregularly mixed with darker; dorsal third mixed with grey-whitish, and marked with longitudinal rows of small spots or strigulae of blackish irroration; costa spotted and strigulated with blackish; a large subtriangular blotch of dark fuscous suffusion extending on costa from about  $\frac{1}{4}$  to  $\frac{1}{2}$ , its apex in middle of disc, posterior edge slightly concave, margined by an ochreous-whitish blotch extending to termen and nearly to tornus, containing a roundish central spot of brown suffusion connected with middle of termen by a brown and black streak: cilia ochreous-whitish, barred with brown sprinkled with blackish. Hindwings light fuscous, suffusedly spotted with darker; dorsal edge clothed with dense long hairs, beneath with a deep iridescent groove filled anteriorly with long ochreous-yellow hair-scales and edged interiorly with rough blackish-grey hairs; cilia whitish-ochreous, with fuscous subbasal shade.

N.S.W.: Sydney; in October, one specimen. An abnormal species, recalling some forms of *Argyroploca*, but there is no basal pecten in hindwings.

36. *Xenothictis*, n.g.

Palpi long, porrected, basal joint considerably elongated, swollen, second joint long, clothed with dense appressed scales



diminishing to apex, terminal joint absent. Thorax smooth. Forewings with 3 from angle, 7 separate, to termen. Hindwings with termen indented or excised above middle; 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 closely approximated towards base.

Type *X. paragona* Meyr. Probably related to *Cnephasia*; it has the neurulation of *Tortrix*, but differs by the peculiar palpi and form of hindwings.

266. *X. paragona*, n.sp.

♀. 23 mm. Head, palpi, and thorax pale brownish-ochreous. Abdomen grey. Forewings elongate, posteriorly dilated, costa gently arched towards extremities, somewhat sinuate in middle, apex obtuse, termen slightly sinuate, little oblique; light brownish-ochreous sprinkled with brown; a few minute black strigulae on costa; edge of basal patch indicated on upper third by a sinuate line of black specks; a small cloudy reddish-fuscous dot on end of cell; an angulated subterminal series of minute black dots on veins: cilia light ochreous (imperfect). Hindwings with termen deeply excavated above middle, so as to form an obtuse prominence on vein 3; grey, darker posteriorly.

LOYALTY Is.: Lifu; one specimen.

267. *X. semiota*, n.sp.

♀. 23 mm. Head, palpi, and thorax brown. Abdomen grey. Forewings elongate, posteriorly dilated, costa gently arched towards base, somewhat sinuate in middle, nearly straight posteriorly, apex obtuse, termen faintly sinuate, little oblique; brown, faintly lilac-tinged; basal patch small, edge indicated by several small black dots, angulated in middle; a small dark fuscous spot on costa before middle, a small dark fuscous spot of raised scales on fold beneath it, and two or three small black dots between these; indistinct irregular slightly darker patches on costa at  $\frac{2}{3}$ , before tornus, and towards termen, edged with scattered small blackish strigulae: cilia ochreous-brownish, on costa barred with dark grey. Hindwings sinuate-indented on

upper half of termen; dark grey, obscurely darker-strigulated; cilia grey, with darker subbasal shade.

LOYALTY Is.: Lifu; one specimen.

### 37. *DIAC TENIS* Meyr.

*Diactenis* Meyr., Journ. Bomb. Nat. Hist. Soc.

xvii., 979(1907) ... .. type *pteroneura*.

Antennæ in ♂ moderately ciliated. Palpi moderate, porrected, second joint with rough projecting scales diminishing to apex, terminal short. Forewings with tufts of scales on surface; 1b simple, 3 and 4 closely approximated from angle, 7 separate, to termen, cell in ♂ very short and narrow. Hindwings  $\frac{1}{2}$ , cilia  $1\frac{1}{4}$ ; 3 and 4 separate, cell open between 4 and 6, 4 and 5 rising as branches of parting-vein from near base, 6 and 7 as branches of upper margin of cell from before middle.

Only one species is known at present; it may be regarded as a development of *Argyrotoxa*.

### 268. *D. pteroneura* Meyr.

(*Diactenis pteroneura* Meyr., Journ. Bomb. Nat. Hist. Soc. xvii., 980.)

♂♀. 8-10 mm. Forewings whitish-ochreous, pellucid between veins, veins fringed with ochreous and dark fuscous scales; upper half of central fascia ochreous, suffused on costa with blackish; a curved posterior transverse series of black specks in disc. Hindwings pellucid, veins fringed with whitish and grey scales.

Q.: Cairns(Dodd); in October, one specimen. Also from India and Ceylon.

### 38. *ARGYROTOXA* Stph.

*Argyrotoxa* Steph., Cat. Brit. ii., 189(1829)

(prav. *Argyrotoxa*) ... .. type *bergmanniana*.

*Epitrichosma* Low., Trans. Roy. Soc. S. Austr.

1908, 320 ... .. type *neurobapta*.

Antennæ in ♂ ciliated. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal

short. Thorax with small crest. Forewings with tufts of scales on surface; 3 from or near angle, 7 separate, to termen, 8 sometimes from before angle, cell sometimes narrow in ♂. Hindwings with 3 and 4 connate, 5 approximated to 4 at base, 6 and 7 approximated towards base.

A small genus widely distributed in the Northern Hemisphere.

269. *A. neurobapta* Low.

(*Epitrichosma neurobapta* Low., Trans. Roy. Soc. S. Austr. 1908, 320.)

♂. 13-14 mm. Forewings with costa clothed with dense rough hairs from base to  $\frac{3}{4}$ . Abdomen deep ochreous-yellow, with large expansible pencil of very long light fuscous hairs from each side before middle, reaching to apex.

Q.: Cairns (Dodd); from October to December.

270. *A. lyssodes*, n.sp.

♂. 21 mm. Head and thorax whitish-ochreous. Abdomen ochreous-whitish. Forewings suboblong, slightly dilated posteriorly, costa gently arched, apex rounded-obtuse, termen slightly rounded, almost vertical; whitish-ochreous, strewn with small brownish spots and strigulae, base of scales hyaline; these indicate a basal patch with oblique somewhat curved edge, a rather broad central fascia, a blotch from tornus reaching  $\frac{2}{3}$  across wing, an elongate irregular spot beneath costa posteriorly, and a rounded spot before middle of termen, these three last and a longitudinal streak through disc irrorated with blackish. Hindwings and cilia ochreous-whitish.

N. GUINEA: Sogeri; one specimen.

39. *DICHELOPA* Low.

*Dichelopa* Low., Trans. Roy. Soc. S. Austr. 1901,

76 ... .. type *panoplana*.

Antennae in ♂ shortly ciliated. Palpi moderate, porrected or subascending, second joint with rough projecting scales above and beneath, terminal short. Thorax smooth. Forewings with 3

from angle, 7 and 8 stalked, 7 to costa. Hindwings with 3 and 4 stalked or coincident, 5 closely approximated at base, 6 and 7 stalked.

Allied to *Drachmobola*; an endemic genus.

271. *D. panoplana* Meyr.

(*Dichelia panoplana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 480; *Dichelopa dichroa* Low., Trans. Roy. Soc. S. Austr. 1901, 76.)

N.S.W.: Broken Hill (Lower), Murrurundi, Bathurst—S. AUSTR.: Goolwa, Port Victor (Lower), Petersburg—W. AUSTR.: Geraldton; in October, November, and May. I have a note that the larva feeds on *Dodonæa*, but no further particulars.

272. *D. loricata*, n.sp.

♂. 9-10 mm. Head and thorax yellow-ochreous mixed with leaden-grey, face with two whitish bars. Palpi yellow-ochreous sprinkled with grey, base and apex whitish. Abdomen dark fuscous. Forewings elongate, costa gently arched, apex obtuse, termen very obliquely rounded; bronzy-ochreous sprinkled with dark fuscous; a series of irregular silvery-whitish spots along costa; about six irregular narrow blue-leaden metallic transverse fasciæ not reaching costa, and some additional spots along dorsum and termen: cilia bronzy-ochreous, with an indistinct grey line. Hindwings with 3 absent; dark fuscous; cilia fuscous, basal third dark fuscous.

Q.: Warwick (Turner)—N.S.W.: Murrurundi; from September to November, four specimens.

273. *D. achranta*, n.sp.

♂♀. 12-14 mm. Head, palpi, and thorax light orange-yellowish, sometimes mixed with whitish. Abdomen grey. Forewings elongate, costa gently arched, apex obtuse, termen obliquely rounded; light ochreous-yellowish or orange-yellowish, in paler examples apparently suffusedly mixed with silvery-whitish, in darker specimens with numerous small silvery-whitish spots arranged in transverse series, usually with some scattered dark

fuscous specks, sometimes tending to form strigulae; sometimes a deeper orange suffusion extending as a broad more or less defined streak above middle from base to apex; costal edge tending to be whitish, sometimes very indistinctly strigulated with fuscous: cilia whitish-yellowish. Hindwings with 3 absent; grey; cilia whitish-grey, with grey subbasal shade.

S. Austr.: Petersburg, Port Lincoln; in October and November, eight specimens.

274. *D. tarsodes*, n.sp.

♂♀. 11-13 mm. Head and thorax ochreous-yellow. Palpi whitish, second joint centrally suffused with ochreous-yellow. Abdomen grey. Forewings elongate, costa gently arched, apex obtuse, termen very obliquely rounded; ochreous-yellow, with numerous small silvery-whitish spots arranged in transverse series; costal edge more or less irrorated finely with grey between spots: cilia pale ochreous-yellowish. Hindwings with 3 and 4 stalked; grey; cilia whitish-grey.

N.S.W.: Mount Kosciusko, 2700 feet; in January, twelve specimens. A constant species, differing from similar varieties of the preceding variable species by the more oblique termen of forewings, and the presence of vein 3 in hindwings.

275. *D. sabulosa*, n.sp.

♂♀. 13-16 mm. Head and thorax whitish-ochreous, suffused on sides with deep ochreous. Palpi ochreous, scales above and beneath whitish. Abdomen ochreous-whitish. Forewings elongate, costa gently arched, apex obtuse, termen rounded, in ♂ rather strongly oblique, in ♀ very oblique; light ochreous-yellowish, suffusedly strigulated with brownish-ochreous or ferruginous-ochreous, in ♀ with a rather broad suffused streak of pale ground-colour beneath costa from base to beyond middle: cilia ochreous, paler towards tips. Hindwings with 3 and 4 stalked; whitish-fuscous; cilia grey-whitish.

Q.: Killarney (Turner); in October, four specimens.

## 40. DRACHMOBOLA Meyr.

*Drachmobola* Meyr., Journ. Bomb. Nat. Hist. Soc.

xvii., 978(1907) ... type *periastra*.

Antennæ in ♂ shortly ciliated. Palpi moderate, porrected, second joint with rough projecting scales beneath, terminal moderate or rather long. Forewings with small tufts of scales on surface; 3 from angle, 7 to termen, 8 and 9 out of 7. Hindwings with 3 and 4 connate or short-stalked, 5 approximated, 6 and 7 stalked.

Belongs to the group of *Spatalistis* and *Argyrotoxa*, in which it is immediately distinguished by the neuration. The only described species is from India.

276. *D. strigulata*, n.sp.

♂. 9-10 mm. Head whitish-ochreous, face whitish. Palpi white, second and terminal joints with faint grey subapical bands, terminal joint rather long. Antennal ciliations minute. Thorax whitish, indistinctly spotted with brownish. Abdomen grey. Forewings elongate, hardly dilated posteriorly, costa gently arched, apex obtuse, termen sinuate, somewhat oblique; whitish-ochreous tinged with brownish, strewn with brown or dark fuscous strigulæ; costa strigulated with blackish; basal patch, costal portion of central fascia, and sometimes a narrow terminal fascia more or less spotted with brownish suffusion; about twenty small round silvery-leadén-metallic spots, arranged principally in transverse rows on these markings and along dorsum and termen: cilia whitish-ochreous, barred with brownish and with a dark fuscous subbasal line except on a clear patch on upper half of termen. Hindwings whitish-ochreous strigulated with fuscous, towards costa suffused with grey, on lower part of termen with several small leadén-metallic spots; cilia pale greyish-yellowish, with interrupted dark fuscous subbasal shade.

Q.: Cairns(Dodd), in August and November, two specimens.

277. *D. ignitis*, n.sp.

♀. 13-14 mm. Head and thorax grey mixed with pale ochreous and dark fuscous. Palpi pale ochreous suffusedly irrorated with

dark fuscous except at apex of joints, scales of second joint long, terminal joint moderate. Abdomen fuscous. Forewings elongate, costa gently arched, apex obtuse, termen somewhat sinuate, rather oblique; grey, with very irregular transverse striae of black irroration mixed with whitish-ochreous; between these are thick irregular leaden-metallic striae: cilia grey, irrorated with whitish and blackish points. Hindwings rather dark grey; cilia grey.

Q.: Cairns(Dodd); in November, two specimens.

#### 41. TYMBARCHA Meyr.

*Tymbarcha* Meyr., Journ. Bomb. Nat. Hist. Soc.

xviii., 622(1908) ... .. type *cerinopa*.

Antennae in ♂ minutely ciliated. Palpi moderate, porrected, second joint with rough projecting scales above towards apex, terminal joint short. Forewings with small tufts of scales on surface; 3 and 4 stalked, 5 approximated, 7 and 8 stalked, 7 to termen. Hindwings with 3 and 4 stalked, 5 approximated, 6 and 7 closely approximated towards base.

Founded on one Indian species; a development of *Spatalistis*.

#### . 278. *T. glyocera*, n.sp.

♀. 13 mm. Head, palpi, thorax, and abdomen pale whitish-ochreous. Forewings elongate, costa gently arched, apex obtuse, termen sinuate, somewhat oblique; whitish-ochreous; markings ochreous, infuscated on costa, with numerous tufts of raised scales, and a few scattered black specks; basal patch indicated by two striae, obtusely angulated in middle; central fascia distinct on costal half, moderate, terminated beneath by a black scaletuft in middle of disc; four or five small spots on costa posteriorly, and indications of striae proceeding from these: cilia pale whitish-ochreous. Hindwings grey-whitish; cilia whitish.

Q.: Cairns(Dodd); in November, one specimen.

#### 42. SPATALISTIS Meyr.

*Spatalistis* Meyr., Journ. Bomb. Nat. Hist. Soc.

xvii., 978(1907) ... .. type *rhopica*.

Antennæ in ♂ simple or minutely ciliated. Palpi moderately long, porrected, second joint with rough projecting scales above and beneath, terminal moderate. Forewings with tufts of scales on surface; 3 and 4 stalked, 7 separate, to termen. Hindwings with 3 and 4 stalked, 5 approximated, 6 and 7 closely approximated towards base.

A genus of several Indian species; together with the four preceding genera it forms a group derivable from *Peronea*.

279. *S. nummifera*, n.sp.

♂. 11 mm. Head, palpi, and thorax light yellow. Abdomen grey, anal tuft ochreous-whitish. Forewings suboblong, costa moderately arched, apex obtuse, termen sinuate, rather oblique; clear yellow, with scattered ferruginous-orange dots and strigulae; three small patches on costa at base,  $\frac{1}{3}$ , and beyond middle mixed with fuscous and spotted with bright leaden-metallic; a patch on middle of dorsum, and a large irregular patch on tornus and lower part of termen reaching half across wing ferruginous-orange somewhat mixed with fuscous and spotted with bright leaden-metallic; several small pale metallic spots towards apex; cilia pale yellow, on tornus mixed with ferruginous-orange. Hindwings grey, rather darker posteriorly; cilia grey.

N. GUINEA: Sudest Island(Meek); one specimen.

280. *S. conchodes*, n.sp.

♂. 9 mm. Head and thorax whitish-ochreous. Palpi whitish-yellowish, becoming white towards apex. Abdomen grey. Forewings suboblong, costa moderately arched, rather bent towards base and beyond middle, apex obtuse, termen sinuate, hardly oblique; light ochreous-yellowish, with violet-silvery iridescence; basal patch with rather oblique edge, moderately broad rather oblique central fascia, a moderate fascia from  $\frac{1}{4}$  of costa to tornus, and narrow terminal fascia formed by yellow-ochreous suffusion, indistinct, marked with small tufts of scales, some of which are sprinkled with blackish; cilia light yellow. Hindwings light grey; cilia whitish-grey.

N. GUINEA: Sudest Island(Meek); one specimen.



43. *SCOLIOPLECTA* Meyr.*Scolioplecta* Meyr., Proc. Linn. Soc. N. S. Wales,1881, 646 ... .. type *comptana*.

Antennæ in ♂ moderately ciliated. Palpi moderate, porrected, second joint with rough projecting scales above and beneath, terminal joint short. Thorax with small crest. Forewings with tufts of scales on surface; 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 connate, 5 nearly parallel, 6 from angle, 7 remote, rising from upper margin of cell considerably before angle.

An endemic genus, related to *Peronea*.

281 *S. comptana* Walk.

(*Sciaphila comptana* Walk., Cat. xxviii., 353; *Scolioplecta comptana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 646.)

♂♀. 14-20 mm. Varies considerably; the white bands of forewings are sometimes wholly suffused with rather dark fuscous. Readily distinguished from the following species by the smaller size, dark head, somewhat less oblique termen of forewings, and differently coloured hindwings.

Q.: Stradbroke Island (Turner)—N.S.W.: Murrurundi, Sydney, Blackheath (3600 feet)—Vic.: Sale (Miss M. Wise)—TASM.: Campbelltown, George's Bay—S. AUST.: Mount Lofty; from September to April.

282. *S. molybdantha*, n.sp.

♂. 22-24 mm. Head white. Palpi white, more or less sprinkled with dark fuscous. Antennal ciliations  $\frac{2}{3}$ . Thorax white, shoulders and crest suffused with dark fuscous. Abdomen dark grey, segments more or less suffused with whitish towards base, anal tuft whitish-ochreous. Forewings elongate, posteriorly dilated, costa slightly arched, apex obtuse, termen slightly rounded, rather oblique; white, with more or less marked grey or brownish transverse striæ; markings grey more or less suffused with brown, and variably sprinkled or marked with black,

especially on veins posteriorly, with numerous tufts of bluish-leadenscales tipped with black; costa variably strigulated with blackish and white; basal patch rather large, outer edge oblique, irregular; central fascia moderately broad, slightly curved, oblique; an apical patch, its edge running from  $\frac{3}{4}$  of costa to tornus, slightly concave; a white terminal line dotted with black: cilia white, basal third grey tipped with blackish, with two posterior blackish-grey lines. Hindwings grey, darker posteriorly; cilia whitish, with basal third dark grey, and grey postmedian shade.

W. AUST.: Waroona (Berthoud); in January and February, three specimens.

44. *PARASTRANGA*, n.g.

Antennæ in ♂ shortly ciliated. Palpi long, porrected, second joint with dense projecting scales above and beneath diminishing to apex, terminal joint moderate. Forewings with slight scale-tufts on surface; 3 from angle, 7 separate, to termen, 8 and 9 stalked. Hindwings with 3 and 4 connate, 5 approximated, 6 and 7 closely approximated towards base.

An interesting form, derived from *Peronea*.

283. *P. macrogona*, n.sp.

♂♀. 14-16 mm. Head and thorax whitish-ochreous, in ♂ suffused with light grey. Palpi grey more or less mixed with light brownish-ochreous, towards base white. Abdomen ochreous-whitish mixed with light grey. Forewings elongate, rather dilated posteriorly, costa towards base gently arched, posteriorly nearly straight, apex obtuse, termen straight, oblique; light brownish, sometimes tinged with reddish, more or less irrorated with whitish-ochreous, with a few blackish specks; costa and dorsum shortly strigulated with blackish irroration; basal patch indicated by some small blackish strigulae; a very elongate-triangular ferruginous-reddish patch, more or less suffusedly mixed with grey and sprinkled with black, extending along costa from before  $\frac{1}{4}$  to near apex, its apex reaching nearly to middle of disc and sometimes marked with black; sometimes this patch

is edged with whitish suffusion; an interrupted black terminal line or series of strigulae, suffused with ferruginous-reddish: cilia pale grey, above apex with a whitish patch. Hindwings light grey; cilia whitish-grey, with darker subbasal line.

W. Austr.: Perth, Albany; in October, six specimens.

#### 45. *EBODA* Walk.

*Eboda* Walk., Cat. xxxv., 1804(1866) ... type *smaragdinana*.

Antennae in ♂ minutely ciliated. Palpi moderate, subascending, second joint with dense projecting scales towards apex beneath, terminal joint moderate. Thorax without crest. Forewings with tufts of scales on surface; 3 and 4 stalked, 7 separate, to termen (sometimes indefinite). Hindwings with 4 absent, 5 somewhat approximated, 6 and 7 closely appressed towards base.

A development of *Peronea*; two or three Indian species are known.

#### 284. *E. smaragdinana* Walk.

(*Eboda smaragdinana* Walk., Cat. xxxv., 1805; Meyr., Journ. Bomb. Nat. Hist. Soc. xvi., 587.)

♂♀. 14-17 mm. Forewings deep emerald-green; costa dotted with rosy-whitish; a round spot in disc beyond middle and bar connecting it with dorsum outlined with whitish; a leaden-grey terminal stripe preceded by a white line; sometimes these markings are suffused with brownish or dark grey, and there is a tornal brown and grey blotch. Hindwings dark grey.

SOLOMON ISLES: Choiseul, Isabel I. (Meek)—NEW GUINEA. Also from India and Ceylon; probably attached to some tree or shrub of cultivation.

#### 285. *E. exerintia*, n.sp.

♂♀. 15-16 mm. Head light brownish, crown suffused with whitish-ochreous, lower half of face whitish. Palpi whitish, with a line of blackish scales on side, towards apex sprinkled with dark fuscous. Thorax light brownish. Abdomen fuscous or dark fuscous. Forewings suboblong, costa abruptly arched and rough-scaled near base, beyond middle with an obtuse rough-

scaled prominence, apex rounded off, termen vertical, rounded beneath; termination of 7 indefinite; light brownish or reddish-fuscous, irregularly clouded with darker towards dorsum; some small dark fuscous spots on costa, especially towards posterior prominence, and in ♂ a darker fuscous patch extending along costa from base to prominence, suffused with bronzy-green towards each end; dorsum strigulated with dark fuscous; some small scattered tufts of whitish and black scales in disc; two blackish dots above and below fold about  $\frac{1}{4}$ , and two others about middle, in ♂ distinct and edged with whitish suffusion, in ♀ less marked; a darker fuscous marginal streak round apex and termen: cilia whitish-ochreous mixed with light reddish-fuscous and grey. Hindwings dark fuscous, in ♂ lighter and tinged with bronzy-yellow except towards apex; cilia greyish.

Q.: Brisbane (Turner); in April, four specimens. In this species the apex of forewings is obliquely rounded so that it is impossible to say where the actual apex is, and the termination of 7 is therefore indefinite; in *E. smaragdinana* the apex is well-defined, and 7 clearly ends in termen; the two species being closely allied, and having all other structures identical, we are justified in this instance in classing the indefinite termination with the terminal.

## 46. PERONEA Curt.

<i>Peronea</i> Curt., Brit. Ent. i., 15(1824) ...	...	type <i>cristana</i> .
<i>Acalla</i> Hb., Verz. 383(1826) ...	...	type <i>hastiana</i> .
<i>Acleris</i> Hb., Verz., 384(1826) ...	...	type <i>aspersana</i> .
<i>Oxygrapha</i> Hb., Verz. 386(1826) ...	...	type <i>literana</i> .
<i>Croesia</i> Hb., Verz. 392(1826) ...	...	type <i>holmiana</i> .
<i>Teras</i> Tr., Schmett. Eur. vii., 233(1829) ...	...	type <i>caudana</i> .
<i>Phricanthus</i> Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 636 ...	...	type <i>aspersana</i> .
<i>Polylepha</i> Low., Trans. Roy. Soc. S. Aust., 1901, 71 ...	...	type <i>epiderma</i> .

Antennæ in ♂ shortly ciliated. Palpi moderately long, porrected, second joint with projecting scales above and beneath, terminal moderate. Thorax sometimes with crest. Forewings

with tufts of scales on surface, 3 and 4 sometimes stalked, 7 separate, to costa. Hindwings with 3 and 4 connate or short-stalked, 5 approximated to 4, 6 and 7 closely approximated towards base.

A genus of some extent, principally characteristic of the Northern Hemisphere and South America. Many of the species are remarkable for their great variability. The generic synonymy is only partially given above.

286. *P. asperana* Meyr.

(*Phricanthes asperana* Meyr., Proc. Linn. Soc. N.S. Wales, 1881, 636; *Polylopha elaphris* Low., Trans. Roy. Soc. S. Austr. 1908, 319.)

♂♀. 13-19 mm. Forewings with 7 and 8 connate or closely approximated, but not stalked as stated.

Q.: Cairns (Dodd), Rockhampton (Barnard), Stradbroke I., Mount Tambourine (Turner)—N.S.W.: Newcastle, Sydney; from October to January.

287. *P. flexilineana* Walk.

(*Sciaphila flexilineana* Walk., Cat. xxviii., 345; *Phricanthes macroura* Low., Trans. Soc. S. Austr. 1908, 322.)

♂♀. 18-22 mm. Forewings elongate, much dilated posteriorly; grey mixed with whitish, with scattered black dots and strigulae; costal edge black margined beneath with brown, and marked with pairs of white strigulae; an irregular black longitudinal streak above middle from base to near apex, broken into five or six segments, more or less edged with whitish suffusion above and partially margined with brown beneath; a spot of dark grey suffusion in disc beneath middle; two or three leaden-grey striae posteriorly. Hindwings rather dark fuscous.

N.G.: St. Aignan Island (Meek)—QUEENSLAND (Lower); from August to October. Also from the Philippines, India, and Ceylon.

288. *P. epidesma* Low.

(*Polylopha epidesma* Low., Trans. Roy. Soc. S. Austr. 1901, 71; *Oxygrapha porpacias* Meyr., Journ. Bomb. N. H. Soc. xviii., 625.)

♂♀. 16-19 mm. Forewings elongate, variably mixed with grey and whitish, with numerous transverse ridges of raised scales; sometimes an irregular black patch in disc before middle, or a black streak along posterior part of fold, or a broad streak of dark fuscous suffusion along dorsum throughout, or a patch of blackish-grey suffusion on costa about  $\frac{2}{3}$ , sometimes extended so as to occupy entire apical  $\frac{2}{3}$  of wing and tinged with purplish, or these markings may be variously combined. Hindwings dark fuscous, lighter anteriorly.

Q.: Cairns, Townsville (Dodd), Duaringa (Barnard), Brisbane (Turner); from November to January. Also from Siam and Ceylon. Very variable; differs from the two preceding species in the forewings not being dilated posteriorly.

#### 47. *PALÆOTOMA* Meyr.

*Palæotoma* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 422 ... .. type *styphelana*.

Antennæ in ♂ strongly ciliated. Palpi long, porrected, second joint arched upwards, with dense rather appressed scales, terminal joint in ♂ moderate, in ♀ long. Thorax without crest. Forewings with tufts of scales on surface, 3 from angle, 7 separate, to termen. Hindwings with 3 and 4 remote, nearly parallel, 4 from angle, 5 approximated to 4 at base, 6 and 7 stalked.

An early form, allied to *Peronæa*; endemic.

#### 289. *P. styphelana* Meyr.

(*Palæotoma styphelana* Meyr., Proc. Linn. Soc. N. S. Wales, 1881, 423.)

N.S.W.: Sydney—Vic.: Gisborne (Lyll), Birchip (Goudie), Melbourne—S. Austr.: Mount Lofty—W. Austr.: Geraldton; from September to January. Larva feeding in galls formed of a metamorphosed shoot of *Eucalyptus*.

#### 48. *MICTONEURA* Meyr.

*Mictoneura* Meyr., Proc. Linn. Soc. N. S. Wales,

1881, 419 ... .. type *Azanimana*.

Antennæ in ♂ dentate, moderately ciliated, basal joint with apical scale-tooth anteriorly. Palpi long, porrected, second joint above with projecting scales diminishing to apex, terminal joint in ♂ moderate, in ♀ long. Thorax with crest. Forewings with tufts of scales on surface; 3 from angle, 7 to termen, 8 and 9 stalked, closely approximated to 7 at base. Hindwings with 3 and 4 connate or short-stalked, 5 approximated to 4 at base, 6 and 7 closely approximated towards base.

An interesting endemic genus, clearly indicating affinity with the *Argyroploce*-group of the *Eucosmidae*, from which I consider the *Tortricidae* to have been derived; the genus *Articolla* in that group is structurally very similar, with 8 and 9 of forewings stalked.

290. *M. flexanimana* Meyr.

(*Mictoneura flexanimana* Meyr.; Proc. Linn. Soc. N. S. Wales, 1881, 420.)

The colouring would have been better described as fuscous with the base of all scales whitish, producing the effect of fine striation.

N.S.W.: Newcastle, Sydney; from September to December.

This concludes the family *Tortricidae*; the remaining families will be given in a second instalment to follow shortly, and a full index to all generic and specific names in both instalments will accompany this.

# THE FATTY ACIDS OF BRAIN LIPOIDS.

## PART i.

BY E. C. GREY, B.Sc., JUNIOR DEMONSTRATOR IN PHYSIOLOGY IN  
THE UNIVERSITY OF SYDNEY.

(*From the Physiological Laboratory of the University of Sydney.*)

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#### Historical.

Part i. The fatty acids obtained by complete saponification of  
brain-substance.

The development of lipid chemistry is reviewed by Bang\* and by Glikin.† It is intended here to bring together the work done with regard to the fatty acids of lipoids.

Diakonow in 1868(1) showed that various fractions of phosphatides could be obtained, differing in the nature of their fatty radicle. He separated substances containing oleic and stearic acid; subsequently Strecker(2) added palmitic acid. Thudichum(3) showed that lecithin always contains oleic acid and another acid. Acids more unsaturated than oleic acid have been found by Henriques and Hansen(4), and Cousin(5) in lecithin of eggs and brain-substance; and by Erlandsen(6) in heart and voluntary muscle.

Thudichum noted the existence of unknown fatty acids in paramyelin, kephalinic acid in kephalin, and an oxyacid in amido- and sphingomyelin. Koch(7) obtained from kephalin dihydroxy-

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\* *Ergebnisse der Physiologie*, Bd. vii. 1907.

† *Handbuch der Biochemie* (Oppenheimer), 1907.



stearic acid without oxidation. As regards the fatty acids of protagon, reliable data are wanting.

Although, however, much labour has been expended on lipoids, most of it has drifted in the wrong direction of examining by qualitative means substances ill-characterised and obtained by chance solvents. No problem in biochemistry could be more definite than that of determining the proximate constituents of various organs, and these must surely be known before we are concerned with the more complex structures into which they may be built. The most obvious step in advancing our knowledge of the lipoids is to examine the fatty acids. Hartley\* has rightly entered the field in his examination of the fats of viscera. This author has shown that his results apply to a great extent to the lipoids. In the case of the brain, however, what is said of the fatty acids applies chiefly to those combined as lipoids, the quantity of free fat being negligible.

On the following page is given in tabulated form a review of our knowledge of the fatty acid radicles of lipoids up to the present time.

The object of this work is to examine the fatty acids of brain lipoids. Part i. deals with the total fatty acids as obtained by direct saponification of the brain.

#### LITERATURE.

- (1) DIKONOW—*Chl. Med. Wissenschaft*, 1868.
- (2) STRECKER—*Annalen der Chem. Pharm.* Bd. cxlviii., s. 77, 186.
- (3) THUDICHUM—*Chem. Konst. der Gehirns der Menschen u. Tieren* Tübingen, 1909.
- (4) HENRIQUES & HANSEN—*Skandr. Arch. für Physiol.* Bd. xiv. p. 3, 1903.
- (5) COUSIN—*Comptes Rendus Soc. Biol.* tome 55, 1903.
- (6) ERLANDSEN—*H. S. Zt. Physiol. Chem.* Bd. 54, ss. 71, 83, 104, 1907.
- (7) KOCH—*Zt. Physiol. Chem.* Bd. 36.
- (8) ZUELZER—*ib.* Bd. 27, s. 259, 1899.
- (9) BARKOFF—*ib.* Bd. 55, s. 395, 1908.
- (10) KOSSEL U. FREYTAG—*ib.* Bd. 17, s. 431, 1893.

\* Hartley, *Journal of Physiology*, Vol. xxviii. p. 353 (1909).

Lipoid.	Class.	Origin.		Nature of Fatty Acid.	Remarks.
Lecithin .....	Monamino-mono-phosphatides.	Egg yolk.	Henriques & Hansen(4)	Oleic and linoleic	These were not pure lecithins.
" .....	"	Ox brain.	Cousin(5) Henriques & Hansen.	beai stearic and palmitic. Linolenic besides others.	
" .....	"	Ox heart-muscle.	Ed(6)	Same as egg lecithin. Fatty acids poor in hydrogen must contain linoleic series or higher.	
" .....	"	Ox brain.	Zuelzer(8).	Palmitic acid.	Not very conclusive.
Kephalin .....	"	Ox brain.	Koch(7).	Dioxy stearic acid.	
Verathin .....	Monamino-mono-phosphatide.	Ox pancreas.	Fränkel & Pari.	Unsaturated acids. Myristic acid and ar unknown unsaturated acid.	Data not very complete.
Coorin .....	Monamino-di-phosphatide.	Ox heart-muscle.	Erlandsen.	Fatty acid with low percentage of hydrogen.	ate
Unnamed .....	Diamino-mono-phosphatide.	do.	Erlandsen.	Fatty acid $C_{22}H_{39}O$	This com] tion calculate
Jecorin .....	" .....	Horse-liver.	Beckoff(9).		
Protagon .....	" .....	Brain.	Thudichum(3).	Ner...ostearic acid ( $C_{18}H_{35}O_2$ )	
" .....	" .....	"	Kessel & Freytag (10).	Ste ic acid ( $C_{18}H_{35}O_2$ )	
Amido & sphingo-myelin.	" .....	Human brain.	Thudichum.	Ox acid $C_{21}H_{39}O_4$ $C_{22}H_{39}O_4$	
Total lipoids in tissues.	" .....	Liver (pig).	Hartley.	Liq id fatty acid o h mol. wt.	was not determined whether this was present as lipid or simply as fat.

PART I. FATTY ACIDS OBTAINED BY DIRECT SAPONIFICATION OF  
THE WHOLE BRAIN.

- i. *Total fatty acids in human brain.*
- ii. *The nature of the fatty acids in the human brain.*

Of the methods which have been proposed for the estimation of the fatty acids in tissues, the one which is based on the soundest principle seems first to have been proposed by Liebermann.\* This method has been adopted here with certain modifications† in estimating the total fatty acids in the brain, and also in obtaining larger quantity of the acids for examination. The modifications are necessary for tissues which, like the brain, contain much unsaponifiable matter.

## I. TOTAL FATTY ACIDS IN HUMAN BRAIN.

The fresh brain, freed as far as possible from superficial connective tissue and blood, was pounded in a mortar, and passed through a wire-sieve. The whole was then thoroughly mixed, and samples immediately weighed into small flasks, fifty grms. in each sample, and covered with 150 c.c. of alcohol. These samples were used subsequently as required. For saponification, samples were taken with 25 grms. KOH, and heated for six hours in reflux condenser. The alcohol was partially removed, and the concentrated solution evaporated in a porcelain dish with the addition of sand and sodium bicarbonate. The hard, dried residue was finely powdered, and thoroughly extracted with anhydrous ether till the extracting fluid, on evaporation, left no significant residue of cholesterol. The cholesterol-free soap-powder was then decomposed by HCl, and the fatty acids extracted with ether, washed free of mineral acid, and dried in current of anhydrous CO<sub>2</sub>.

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\*Liebermann, Pflüg. Arch. 72, 360.

† This method has also been modified by Kumagawa and Suto (Biochemische Zeitschrift, Bd. ix., p. 212), but the slight modifications which they have suggested do not entitle them to the claim to be authors of the method. Many subsequent authors also seem to be unaware that Liebermann was the author of this method.

The following figures give the total fatty acids and cholesterol found in moist brain-substance in three such experiments. The results are also given, calculated upon the quantity of solid matter in the brain, as found by drying to constant weight at 100°C. The fallacy in drying lipoid-containing substance in the air at 100°C. will be obvious, but the results are given thus, pending a better meaning of the term "total solids."

	FRESH BRAIN.		CALCULATED TO SOLIDS.	
	Fatty acid.	Cholesterol.	Fatty acid.	Cholesterol.
No.1	5.28	2.19	24.07	9.98
2	4.82	2.28	21.98	10.40
3	4.95	2.18	22.57	9.94
Mean...	5.02	2.22	22.87	10.10

The brain-pulp gave, as average of four estimations, 78.07 % moisture, or 21.93 % total solid matter.

## ii. THE NATURE OF THE FATTY ACIDS OF THE BRAIN.

### *Method of obtaining the fatty acids.*

The brain-substance was saponified in small lots (three), with potash, the whole operation being conducted in an atmosphere of coal-gas; the saponified mixture was then poured into a large flask and treated with excess of  $\text{H}_2\text{SO}_4$  (20 %), or  $\text{HCl}$  (1 in 4), freed from oxygen (by cooling in a stream of coal-gas), ether was added, and the whole transferred to a winchester quart and placed in a shaking machine for one hour; the coloured ethereal layer was separated and concentrated; the concentrated ethereal solution was then resaponified by the method of Kossel and Obermüller.\* This elegant method is well adapted to work of this kind. The precipitated soaps were allowed to stand all night, then centrifuged, and washed repeatedly in the centrifuge with ether (five washings) till the ethereal solution was colourless.

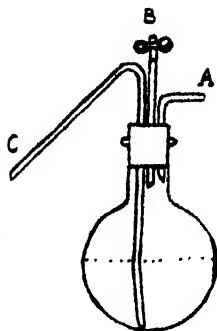
The united sodium-soaps were preserved in dessicators in an atmosphere of  $\text{CO}_2$ .

\* Kossel & Obermüller, H. S. Zeit. phys. Ch., Bd. xiv. 599 (1890).

In the preliminary examination of the fatty acids the soaps were decomposed in the apparatus pictured below.

The object of this apparatus is to liberate and wash the fatty acid in an atmosphere of  $\text{CO}_2$ . Tube A is connected to a Kipp apparatus, and B is kept open.

When the separated fatty acid has risen to the surface, tube B is closed; the force of  $\text{CO}_2$  then drives the watery solution out at C, which continues to siphon till tube B is opened. The apparatus is heated in a water-bath. The washed fatty acid is then transferred to a weighing bottle, and dried at  $100^\circ\text{C}$ . in a current of anhydrous  $\text{CO}_2$ .



*Nature of fatty acids from human brain.*

In a preliminary examination, the lipoids had not been completely decomposed, only a portion of the total fatty acids being split off. For complete splitting up of the lipoids by means of 20 % alcoholic  $\text{KOH}$ , six hours at a boiling temperature is required. An interesting observation was made, however, in that the fatty acids split off most easily from the lipid bodies have a smaller iodine-absorption figure than those more difficult to split off.

The mean iodine-value of the total fatty acids from brain was found to be 81.3 % in twelve to fifteen hours, while a sample obtained by incomplete saponification gave a mean absorption of 51.3 % iodine(Hübl).

The fatty acids split off at an early stage by incomplete saponification are, when first obtained, pale yellow in colour but gradually darken on keeping, and rapidly at  $100^\circ\text{C}$ .; but when the saponification is continued for six hours, the fatty acids obtained are brown in colour.

These results point to the conclusion that the lipoids which most resist saponification contain fatty acids of an unsaturated nature.

**Data for iodine-absorption :**

No.1. 0.4784 grm. fatty acid absorbed 29.7 cc. N/10  $I_2$ —78.85 %  $I_2$ .

No.2. 0.4447 grm. fatty acid absorbed 29.2 cc. N/10  $I_2$ —83.3 %  $I_2$ .

**Slightly impure oleic acid under same conditions :**

No.1. 0.5 grm. absorbed 36.75 cc. N/10 Iodine—93.2 %  $I_2$ .

No.2. 0.5 grm. absorbed 36.20 cc. N/10 Iodine—91.9 %  $I_2$ .

*Separation of saturated and unsaturated fatty acids.*

The separation is based on the solubility of the lead-soaps of the higher unsaturated fatty acids, and the insolubility of those of the saturated fatty acids in ether. The method of Dekonigh and Muter, with the modification of Drechsel, was used. Air was carefully excluded prior to determination of iodine-absorptions.

*The unsaturated fatty acids of human brain.*

The mean iodine-absorption of the liquid fatty acids was found to be 110.6 (in twelve hours, Hübl). Since, under exactly similar conditions, that for oleic acid was much less than this, it follows that the liquid fatty acids of the human brain are more unsaturated than oleic acid.

An approximate calculation of the quantity of linoleic acid which this would represent, shows that the liquid acids contain

Oleic acid..... 87.8 %.

(Equivalent of) linoleic acid..... 22.2 %.

*The saturated fatty acids of human brain.*

The fatty acids which were obtained from the ether insoluble soaps, by decomposition with hot HCl, were washed acid-free with boiling water and dried. The ether-solution was decolourised with animal-charcoal, and gave, on evaporation, perfectly white fatty acids which set, on cooling, to an amorphous mass. The fatty acid had a faint odour of beeswax.

The melting point of the solid fatty acids was 51.4°C.

The mean molecular weight calculated from analysis of lead-soap was 318.7. This interesting result was immediately checked.

by determination of the saponifying equivalent with KOH. The figures, though low compared with lead-estimation, are consistently high, and give a mean molecular weight of 308.3. It is probably difficult to obtain the lead-soap pure.

From these results there can be no doubt that the solid moiety contains fatty acids of molecular weight much higher than those of previously mentioned fatty acids. (The molecular weight of stearic acid is 284). The low melting point of the mixture is also significant, and does not correspond to any simple mixture of palmitic and stearic acids.

*Data for mean molecular weight.*

0.2872 grm. lead-soap gave 0.1033 grm.  $\text{PbSO}_4$  : mean mol. wt. = 318.7.  
Saponification with alcoholic KOH

(1)	3.9812 grm.	neutralised	26.0 cc.	N/2 KOH,	mean mol. wt. =	306.8.
(2)	0.9850	"	"	81.8 cc. N/10 KOH	" " "	309.7.
(3)	1.4786	"	"	48.3 cc. N/10 KOH	" " "	304.1.
(4)	1.4786	"	"	48.6 cc. N/10 KOH	" " "	306.4.

*Separation of the saturated fatty acids.*

This is based on fractional precipitation with magnesium-acetate.

The separation was carried out with 4.5 grams fatty acid, but the results prove definitely the existence of a fatty acid of high molecular weight in the brain as already mentioned.

Four small fractions were separated with the following results:

	Weight of fraction.		Mean mol. wt.		Melting point.
No.1....	1.17 g.	.....	344.2	.....	54.0 C.
No.2....	1.83	.....	291.6	.....	55.5
No.3....	0.68	... ..	288.0		
No.4....	0.40	.....	338.0	.....	52.1

No.4 was obtained by making filtrate from No.3 strongly ammoniacal, and is probably the same as No.1.

Fractions 2 and 3 had many characteristics of a mixture of palmitic and stearic acids, but the colour and low melting point prove them to be more complex.

*Data for molecular weight determinations.*

No.1.	1.1668	grm. neutralised	33.9 cc. N/10 KOH.	Mean mol. wt.	344.2.
No.2.	1.3297	" "	45.6 cc. N/10 KOH.	" " "	291.6.
No.3.	0.5154	" "	17.85 cc N/10 KOH.	" " "	288.7.
No.4.	0.3595	" "	10.45 cc. N/10 KOH.	" " "	338.3.

*General conclusions.*

(1) The fatty acids of the human brain are more complex than has previously been supposed.

(2) The liquid portion contains fatty acid more unsaturated than oleic acid, equivalent to not less than 22 % linoleic acid.

(3) The solid portion contains, besides stearic and palmitic acids, also a fatty acid of high molecular weight but low melting point. It is not crystalline, and probably belongs to a different group from stearic acid.

In conclusion, I beg to express my thanks to Professor Anderson Stuart, in whose laboratory this work was done; and to Dr. H. G. Chapman, at whose suggestion it has been undertaken.



(Continued from p. 158.)

Mr. David G. Stead sent for exhibition the jaws of a great Ocean Sun-Fish, *Mola mola* (Linn.), which had been driven ashore by sharks on the night of the 20th May, at Bondi, near Sydney. While still in the surf, it was secured by Mr. R. S. Courtney, who, with the assistance of a number of other gentlemen, dragged it up on the beach. A series of measurements was taken, the morning after capture: total length (including caudal fin) 8 feet 7 inches; length of caudal fin, 1 ft. 11½ in.; distance from point of snout to vertical from dorsal fin, 4 ft. 11 in.; diameter of eye, 4 in.; width of mouth, 5½ in.; diameter of gill-opening, —; depth of fish through eye, 3 ft. 1½ in.; depth through gill-opening, 3 ft. 9½ in.; depth of body at anus, 4 ft. 7 in.; distance from point of dorsal fin to point of vertical fin, 9 ft. 10 in.; distance from upper margin of eye to dorsal profile of head, 7½ in.; greatest thickness (at pectoral fin), 1 ft. 11 in.; girth at eye, 6 ft. 8 in.; girth at base of pectoral fin, 9 ft.; girth at base of dorsal fin, 11 ft.; height of dorsal fin, 3 ft. 2¾ in.; height of anal fin, 3 ft. 1¾ in.; length of pectoral fin, 1 ft. 1¾ in.; greatest width of pectoral fin, 11½ in.; greatest width of dorsal fin, 2 ft.; greatest width of anal fin, 2 ft.; depth of caudal fin, 3 ft. 10 in.; supra-orbital ridge very strongly developed.

Mr. Fletcher read extracts from a letter written by Mr. F. Foskett Milford, and kindly communicated by Mr. T. H. Smith, of Manly, by the co-operation of Mr. W. Houston, of the Land Court of New South Wales, upon the occurrence of freshwater eels in Norfolk Island. Mr. Milford, formerly a resident on the island, stated that, during a period of drought, he had seen large freshwater eels stranded opposite Deastey's place in the drain known as the water-mill; and that he had been reliably informed of their occurrence in a deep pool, perhaps 12 feet or thereabouts in depth, about 70 yards from the cliff where the Cascades waterfall is in evidence. Marine eels, on the other hand, particularly the green eel, were to be caught all round the island from the water's edge to three miles off or even more.

*Discussion.*—After a brief exposition of President Jordan's views on the subject of geminate species, Mr. Fletcher proceeded to a consideration of the application of Jordan's law to the case of the Australian Batrachia. Mr. Froggatt discussed the case of the Australian Cicadidæ; Mr. Tillyard that of Australian Dragon-flies; Mr. S. J. Johnston weighed the evidence furnished by certain groups of vertebrates and plants, and offered some criticism of the Law on the ground that it conceded too much weight to geographical isolation, and not enough to physiological isolation; Dr. Chapman brought forward some theoretical considerations; and Mr. Maiden discussed the case of Australian plants particularly Eucalypts. On the motion of Mr. Basset Hull, the discussion was adjourned to next Meeting.

WEDNESDAY, JUNE 29TH, 1910.

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The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, June 29th, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

Messrs. WALTER REGINALD BROOK OLIVER, Christchurch, N.Z.; NEVILLE BURKETT, Goulburn; and FREDERICK WYMARK, Sydney, were elected Ordinary Members of the Society.

A letter, forwarded by direction of His Excellency, Lord Chelmsford, State Governor, thanking the Council, as the representative of the Society, for its letter of condolence and sympathy, on the occasion of the death of His Majesty, the late King Edward vii., was read from the Chair.

The attention of Members was called to the Program of the International Hygiene Exhibition to be held in Dresden, 1911, with an accompanying invitation to exhibit in the Scientific Section.

The President announced that Mr. Henry Deane, M.A., F.L.S., &c., had kindly offered to show a series of lantern slides, illustrating the topography and botany of the country along the route of the contemplated Transcontinental Railway Line between Port Augusta, S.A., and Kalgoorlie, W.A., at the next Meeting.

On the President's suggestion it was resolved, with enthusiasm, that the hearty greetings and congratulations of the Members present should be tendered to Professor David, B.A., F.R.S., C.M.G., recently honoured by the Sovereign.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 11 Vols., 75 Parts or Nos., 15 Bulletins, 29 Pamphlets, and one portrait, received from 48 Societies, &c., and 3 Individuals, were laid upon the table.

## NOTES AND EXHIBITS.

Mr. D. G. Stead recorded, as an addition to the fish-fauna of New South Wales, a species of Serranid Perch, *Diagramma crassispinum* Rüppell (= *D. affine* Günther), a fine example of which, measuring 674 mm., and weighing 16½ lbs., had been received by the Department of Fisheries, early in May, from Port Macquarie. He also placed on record the second known occurrence of the Pristipomatid fish, *Therapon jarbua* (Forsk.); a specimen, measuring 143.5 mm., having been received from the same locality. Mr. Stead also showed a piece of conglomerate from a river-bar on the Barwon River, at Old Collymungool Station, a few miles above the junction of the Meei or Gwydir, and the Barwon; and he described the deposit as it appeared in the outcrop on the river. The whole area had the appearance as if blood had been spilled over it and then dried; and from that the Blacks had called the spot "Mul-qui" or "Mul-guaë" (qui or guaë meaning blood). The most interesting thing about this spot, however, was that traces of a series of aboriginal fish-traps, resembling those at Brewarrina, were found. He believed that the Blacks had been led to make these enclosures through observing the natural trapping of Murray cod and other fishes in the holes excavated by Nature in this peculiar conglomerate.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, a small sunfish, *Rantania makua* Jenkins, which had been forwarded to Sydney by the Curator of the West Australian Museum. This species has hitherto been recorded from Honolulu and Japan only, though a specimen has been in the Australian Museum for many years, which was received from Mauritius. Also young specimens of *Cytilus novae*.

*zelandiae* Clarke, from the Victorian coast. They differed from the description of the adult in lacking several important characters, but their identity with the New Zealand species was proved by Mr. Waite, who had compared specimens of different sizes from both localities. A half-grown specimen, from New Zealand, was also exhibited for comparison.

Mr. J. E. Carne showed specimens of tin and wolfram ores from the Butler Tin Mine, Torington, New England, the interesting point being the mode of deposition of the minerals associated in these specimens—viz., quartz, chlorite, cassiterite, and wolfram. Also an interesting rock from Hawkin's Lease, Rockvale Wolfram and Bismuth Mines, Cow Flat, New England, in which the constituents—quartz and felspar—were each perfectly crystallised; but on weathering these minerals were liberated as perfect independent crystals.

Mr. C. F. Laceron, by permission of the Curator of the Technological Museum, exhibited a fine frond of *Cardiopteris polymorpha* Göppert, showing nine pinnules, from the Carboniferous formation at Paterson, N.S.W. This so far has been found only as isolated pinnules. Other exhibits from the Lower Marine Series at Allandale, N.S.W., were a very fine specimen of *Straparollus ammonitiformis* Eth. fil.; and also a well preserved *Keeneia*, showing the band, and possibly synonymous with *Platyschisma rotundatum* Morris.

Mr. Cheel showed a fine series of *Xylostroma giganteum* Fries, a timber-destroying fungus. It is usually found in various species of Eucalypts, in whitish or tan-coloured masses, in some cases resembling chamois leather, and in others of a whitish tough papery nature. The tan-coloured masses very closely resemble the "German Tinder-Fungus" (*Fomes fomentarius* Cooke), and probably belong to a closely allied species of that genus. The white masses are probably the sterile mycelium of *Polyporus eucalyptorum* Fries, which is known to infest various species of Eucalypts. The sterile mycelia are usually forwarded without

the sporophores, so that it is not possible to determine the species. As these are known to be great timber-destroyers, it would be interesting to have fuller information with a view of tracing their life-history. The following is a list of specimens represented in the National Herbarium collection, not mentioned in Mr. J. H. Maiden's "Useful Native Plants of Australia" (pp. 639-640)—(1) In Stringybark (*Eucalyptus eugenioides*), Walcha (A. R. Crawford; May, 1899). Whitish sheets, thin and tough.—(2) In *E. Caleyi* Maiden, Inverell district (J. H. Maiden; June, 1906). Soft and thick whitish masses.—(3) In a living "Red Gum," Wilgo, Cobargo (Lindsay Henry; January, 1910). Thin whitish sheets, communicated by the Curator of the Australian Museum.—(4) In a "White Gum," at Cross Roads, near Sutton Forest (Miss Georgina King). Thick whitish masses.—(5) Host not stated, Parke (O. F. Color; February, 1909). Thin whitish sheets.—(6) In a "Blue Gum," at Cross Roads (Miss Georgina King; July, 1897). Broken sheets of a dark tan-colour; and also terete or finger-like forms found in a "Box-tree" at Riverstone.—(7) Host not given, Macleay River (J. Emms; January, 1899). A fairly large sheet, thick, tan-colour.—(8) In a "Stringybark"; between the core and the wood; said to be fully six feet long. Near Mount Tomah (F. Peck; 1907). This is a beautifully mottled sheet, of a light tan-colour, with darker markings; communicated by Mr. Jesse Gregson.

Dr. Cleland showed a portion of a sand-pipe resembling coral, from the sandhills along the shore of St. Vincent's Gulf at Adelaide [vide T. S. Hall's paper "On certain Incrustations on Wood in Dune-Sand." Victorian Naturalist, xviii., 47, July, 1901].

Mr. T. H. Johnston exhibited a series of Entozoa comprising specimens of (1) *Physaloptera* sp., from the intestine of the Brown Snake, *Diemenia taxtilis* Dum. & Bibr. (syn. *D. superciliosa* Günther), collected near Sydney by Mr. D. Fry; (2) *Porocephalus* sp., from the lung of a Whipsnake, *Diemenia psammophis* Schl. (Sydney). Also a number recently collected by him, by permission of the Curator of the Australian Museum, Sydney, from a

Sword-fish, *Xiphias gladius* Linn., which was found dead on Cronulla Beach, near Sydney, recently, and is now in the Museum collection. The species represented were (3) *Fistulicola plicatus* Rud., a cestode infesting the lower intestine, and frequently producing fistulæ on the outer part of the wall, as a result of penetration; (4) *Tetrarhynchus* sp., an elongate larval form, infesting the muscles; (5) *Tetrarhynchus* sp., a small species, with four comparatively long and delicate rostellæ, found on the mesentery; (6) *Tetrarhynchus* sp., a rather large solid form, with short, thick, rounded rostellæ, also from the mesentery; (7) *Cysticercus* sp., a remarkable cyst with a well defined laminated membrane like that of the common hydatid, *Echinococcus polymorphus* Dies., taken from the liver; (8) *Ascaris incurva* Rud., a nematode infesting the stomach. None of the above-mentioned parasites had been recorded previously from these hosts in Australia. He also exhibited photographs, and a series of potato-tubers which showed the presence of rhizomorph strands on the outside, and of hyphæ within the tuber, belonging to the Agaric, *Armillaria mellea* (Tenterfield, N.S.W.). Some of the tubers were destroyed by the fungus.

Dr. Cuthbert Hall exhibited a hybrid seedling from seed gathered from a cultivated specimen of *Acacia Baileyana*. It had been found that this *Acacia*, when growing near *Acacia decurrens*, gave about 20 % of hybrids, which differed materially from either parent. The hybridisation may probably have been effected by bees, both specimens flowering at the same time. As the two parent-species occur in widely separated localities, the natural barrier of the Great Dividing Range intervening, this has a peculiarly interesting bearing on Jordan's Law.

Mr. T. Steel exhibited a quantity of the dead bodies of an ant *Iridomyrmex nitidus* Mayr, from Herbert River, Queensland, found in March, 1906, in numerous little heaps scattered over the surface of the ground. The heaps varied from a few dozen bodies to many thousands. The ants were busy bringing the bodies and placing them on the heaps. Could this mortality have

been due to an epidemic of some sort? Microscopically the ants exhibit no injury or give any indication of the cause of death.

On behalf of Mr. T. Stephens, of Hobart, Mr. Fletcher exhibited portion of a plank destroyed by "dry-rot," (sp. undetermined) from the floor of a building not more than 10-12 years old, with an unventilated basement. The exhibit showed, very perfectly, the delicate branching form of the mycelium assumed by the fungus in spreading from the rotted joists to the underside of the flooring-boards.

#### DISCUSSION ON JORDAN'S LAW OF GEMINATE SPECIES (*continued.*)

Messrs. A. F. Basset Hull, R. H. Cambage (*Eucalyptus* spp., and *Angophora* spp.), Dr. Cuthbert Hall, E. Cheel (*Callistemon* spp.), and Dr. Cleland (*Meliphagidæ*), took part in the continuation of the discussion. The President summarised the views put forward. The Secretary thanked the Members for their cordial response to the invitation to participate in the discussion.

(A résumé of the discussion will be found after Mr. A. A. Hamilton's paper.)



MONOGRAPH OF THE GENUS *SYNTHEMIS*.

BY R. J. TILLYARD, M.A., F.E.S.

[NEUROPTERA : *Odonata*.]

(Plates iv.-viii.)

## INTRODUCTION.

The genus *Synthemis* was proposed by de Selys, in 1871,\* in order to receive those species of the subfamily *Corduliinae* in which both the basilar and submedian wing-spaces were reticulated. The type of the new genus was *Epophthalmia eustalacta* Burmeister.† De Selys described in his "Synopsis des Cordulines" (1871) five other species of the genus, viz., *S. miranda*, *S. macrostigma*, *S. leachii*, *S. guttata*, and *S. brevistyla*, besides giving his own description of the type *S. eustalacta*, and pointing out the important differences between it and the other species of the genus *Epophthalmia*. Three years later, in his "Additions au Synopsis des Cordulines" (1874)‡ he added two more species, viz., *S. regina* and *S. virgula*. The habitat of all these species was Australia, with the exception of *S. miranda*, whose locality, it is to be feared, will never be ascertained with certainty. The only known specimen of this, the finest and most interesting dragonfly of the genus, was discovered by de Selys, pinned, for ornamentation, into a lady's hat in a shop in Paris. He secured it at once. It is a broken female, lacking five segments of the abdomen. Its locality was stated to be New Caledonia; but though the Museum in Paris is rich in collections from this colony, another specimen has never been taken. It seems, therefore, that the locality is very much open to doubt.

Specimens of the genus continued so rare in collections received in Europe from abroad, that it was not until 1901 that another

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\* Bull. Acad. Belgique, 1871, xxi., p.557.

† Handb. Entom. Névropt. 1839.

‡ Bull. Acad. Belgique, 1874, i., p.29.

species was described, *S. flavoterminalata* Martin.\* Further additions were *S. primigenia* Förster, from New Guinea,† *S. nigra* Tillyard,‡ *S. cyanitincta* Tillyard,§ *S. martini* Tillyard,|| *S. olivei* Tillyard,¶ *S. claviculata* Tillyard.\*\* Through the kindness of Dr. F. F. Laidlaw, of London, who has carefully studied the immature and somewhat damaged type of *S. leachii* Selys, in the British Museum, and has compared it with cotypes of *S. martini* Tillyard, it has been established without doubt that the two are one and the same species. The name *martini* Tillyard, therefore becomes a synonym of *leachii* Selys. This leaves fourteen well-established species in the genus. A new species will be described in this paper, together with the hitherto unknown female of *S. claviculata*, which has just come to light.

The insects comprising this genus are among the most beautiful and graceful of Australian Odonata. But papered specimens invariably lose their beautiful colours, and the bright yellow and creamy spots and stripes often fade away into a dull brown. Apparently this has added considerably to the difficulty of identification; for the genus has always been regarded more or less as a puzzle. It was therefore, to me, a great advantage to be able to study them in the field, when I found that some of the most closely allied species differed both in habit and colouration, and could be separated by the eye, even when flying; though, when dried and placed in a collection, the determination was not so easy. I therefore determined to note carefully the colours of each species, and perpetuate them in water-colour. These drawings are reproduced in the two coloured plates attached to the paper. I venture to hope, on the principle that "an accurate drawing is better than the most lengthy and

\* "Odonates du Continent Australien," Mém. Soc. Zool. France, 1901.

† Ann. Mus. Nat. Hungarici, 1903.

‡ Proc. Linn. Soc. N. S. Wales, 1906, p. 489.

§ Loc. cit. 1907, p. 724.

|| Loc. cit. 1907, p. 726.

¶ Loc. cit. 1908, p. 747.

\*\* Loc. cit. 1908, p. 749.

detailed description," that even those who have no special knowledge of Australian *Odonata* will be able to use the plates with advantage.

Owing to the rarity of specimens of the genus, no detailed study of it has been possible to entomologists outside Australia. Doubtless many new species still lie hidden in out-of-the-way parts of the continent. However, during five years' collecting in various localities, I have gathered together a great number of specimens—every one of which has been carefully examined for variation—and have studied their habits in the field. Further, I have been fortunate enough, after long and careful search, to discover, and identify by breeding, the larvæ of no less than five species, the only ones obtainable within a hundred miles of Sydney. The life-histories of these I have worked out fairly completely.

Those who have studied the peculiar venational characters of the wing of *Synthemis* claim, with justice, that it is the most archaic form of *Cordulina* wing still extant (with the possible exception of the "quadrilateral" genus *Cordulephya*). I hope to shew in the present paper that the morphology of the larva strongly supports this view. The peculiar character of the Australian fauna is evident in every group, and evidence of it is by no means absent in the *Odonata*. Such archaic and isolated forms as *Synthemis*, *Petalura*, *Telephlebia*, and *Phyllopetalia* are of the greatest scientific interest. The study of their life-histories especially should throw a great deal of light on the present-day affinities of the larger and more dominant groups, and enable us to trace the synthetic evolution of existing types. The peculiar characters of the larvæ of *Synthemis*, to be described in this paper, are of especial interest, and throw new light on the relationships of *Cordulina* to other subfamilies.

The objects of this paper are two. Firstly, to discuss the morphological and physiological characters of the group with a view to a satisfactory scheme of subdivision for the genus, and the placing of it in its correct position in the subfamily. Secondly, to give a detailed descriptive account of the separate

species, their life-histories, larval forms, habits and imaginal characteristics, and to supplement these with dichotomous keys and plates shewing parts used in classification.

I am indebted to Dr. Laidlaw for examining the types of *Synthemis* in the British Museum; to M. René Martin, of Paris, for knowledge of the types in the de Selys collection, for the information quoted above about *S. miranda*, and above all for his excellent work on the *Corduliinæ*; and to Dr. Ris, of Rheinau, Switzerland, for many valuable hints on field-work, and for his great interest in, and kindly criticism of my new discoveries.

#### MATERIAL STUDIED.

*Imagines*.—My earliest captures were forwarded to M. René Martin for identification, and he was kind enough to return, with them, some named specimens of his own, which had been compared with de Selys' types. These were specimens of the three closely allied species, *S. brevistyla*, *S. guttata*, and *S. virgula*. In my collection there are two hundred and thirty set specimens of the genus, comprising long series of all the commoner ones. All these have been examined carefully for variation. Besides these, I have examined another hundred or more papered specimens, which have since been sent out to my various correspondents. Of the rare species, I possess two males and three females of *S. nigra*, two males and one female of *S. claviolata*, and two males of *S. oliveri*.

I have never seen the unique female type of *S. miranda*, but fortunately it is well figured in M. Martin's "Cordulines," and de Selys' own description is also available. The series of *S. primigenia* possessed by Prof. Förster of Berlin, is also inaccessible; but I have Förster's careful description, and a good figure in Martin's work above-mentioned.

*Larvæ*.—During the past two years I have collected and reared a considerable number of larvæ, at various stages of growth, of *S. eustalacta*, *S. macrostigma*, and *S. guttata*. Over fifty of these are preserved in my collection. Of *S. regina* I have only five specimens, and of *S. flavoterminalis* a dozen.

The advantage of studying large series in a group subject to considerable variation is self-evident.

The publication of M. René Martin's magnificent "Cordulines, Cataloge Systematique et Descriptif"\* in 1906, has brought to all odonatologists the means of studying this subfamily in detail, and is of special value owing to the great rarity of a large number of the species. Its appearance was the signal for renewed interest in the group, and there followed in quick succession two excellent papers on the scheme of classification of the subfamily. I refer to Williamson's "Revision of the Classification of the *Corduliinae*"† and Needham's "Critical Notes on the Classification of the *Corduliinae*."‡ Williamson's classification is a great advance upon that adopted by de Selys and retained by Martin. Needham suggests further improvements, bringing the comparative study of the *Corduliinae* to a high degree of efficiency.

All this excellent work contains no attempt at studying life-histories or describing the earlier stages of the insects, that being outside their avowed scope. The classification has been adopted on the study of wing-venation only. Furthermore, the genus *Synthemis* has throughout been neglected and left in its Selysian state, owing no doubt to lack of material for the study of it.

In the Williamson-Needham scheme of classification (*wing-venation only*), the subfamily *Corduliinae*, *sens. lat.*, is divided into two groups, which are themselves elevated to the rank of subfamilies, viz.:—

(1) *Macromiinae*, in which the anal loop of the hind-wing is a compact set of cells, of *Cordulegasterine* form, i.e., slightly longer than broad, and the hindwing-triangle is never recessed to the level of the arculus.

(2) *Corduliinae*, *s.str.*, in which the anal loop (when present) is very much elongated, and possesses a longitudinal bisector, and the hindwing-triangle is often recessed to the level of the arculus.

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\* Collections Zoologiques du Baron Edmond de Selys Longchamps, Fasc. xvii., Brussels, 1906.

† Entom. News, Vol. 19, pp. 428-431, 1908.

‡ Annals Entom. Soc. America, Vol. I., No. 4, Dec., 1908.

Under this scheme the genus *Synthemis* falls, apparently naturally enough, into the subfamily *Macromiinae*. From all the other genera in that subfamily it can be distinguished by the presence of cross-veins in the basilar space.

I have found it hard to believe that there is such a close affinity between the slender, graceful, and timid *Synthemis* and the coarsely-veined, swift and rapacious *Macromia*. Apart from the wing-venation, *Synthemis* is absolutely *Corduline* in facies, while *Macromia* is distinctly *Aeschnine*. So much so that, even so acute an observer as Professor Sjöstedt, of Stockholm, has described a female *Macromia* as a new *Aeschnid*.<sup>\*</sup> There are, in fact, distinct *Aeschnid* tendencies in the whole *Macromia*-group, and it will be interesting to see what light the study of life-histories may throw on this question. I propose, however, first of all, to take the whole question of the wing-venation of *Synthemis* and *Macromia*, and to study it in detail. We shall then see where the differences lie.

The essential difference seems to be this. In *Macromia* we have, in its way, as highly evolved and specialised a wing as is to be found in any dragonfly. I do not mean by this that all parts of the *Macromian* wing are as highly evolved as in other groups (for instance, the hindwing-triangle is never recessed, nor is the stigma braced); but that the line of development followed has evolved so beautifully perfect and strong a structure for flight, albeit on simpler lines than in some other groups, that it may well stand as a model of perfect development. Nor do I judge it alone by arbitrary standards of development, so much as by its actual test in the field. The flight of *Macromia* is something to marvel at. When collecting in North Queensland, I found *Macromia tillyardi* and *Synthemis flavotermiuata* flying on the same creek. The contrast could scarcely be greater. Of the latter, specimens would often fly almost into the net, and their only idea of self-preservation was now and then to rise out of reach of the net, continuing their weak to-and-fro flight undis-

<sup>\*</sup> *Hylaechna paludis* Sjöst. = *Macromia melanix* Selys (♀).

turbed, even when struck at repeatedly. The former came and went like a flash of light, so that one might truly say it was gone before one realised that it had come. During a three weeks' stay, I found the males absolutely uncatchable, while of the females I secured only two.

What, then, makes all this difference between two wings whose venation is on so similar a plan? It is surely that in *Macromia* every superfluous vein has been eliminated, and the whole strength of the wing-material thrown into its most useful channels; whereas in *Synthemis*, reduction of cells and cross-veins has proceeded only a little way—not so far, in fact, as in any other *Corduline* genus. Strong evidence of this is the persistence of the cross-veins in the basilar space—an area of the wing which, above all others, needs to be strong and compact, with no lines of weakness. Stronger evidence still is the excessive variability of wing-venation, which can be seen on examining any long series of *Synthemis*—not to mention the frequency of absolute “freak-venation,” of a kind that I have never seen in any other group. Let us examine this venation in detail.

*Cross-veins.*—The number of cross-veins in the basilar space varies, in different species, from one to five; in the submedian space, from three to nine. The position of these, especially in the submedian space, is not constant in the same species. For instance, in *S. regina* male, with five cross-veins, there may be only one beyond the arculus, or two, or one may be directly under the arculus. In the triangles of both wings, which are usually free, cross-veins often occur in one or more of the four wings, and sometimes even there are two cross-veins in a triangle.

*Recession of the hindwing-triangle.*—This line of specialisation, stated by Needham to be *never* present in the *Macromiinae*, is almost accomplished (*quite* in one or two specimens) in *Synthemis cyanitincta* (Plate vi.). Fig. 5 gives the usual position of the arculus, the distance from its base to the inner angle of the triangle being about one-fourth of the whole length of the latter. In all other species the distance is from somewhat under to somewhat over one-half. (Compare the other figures with fig. 5).

*Fusion of arculus-sectors.*—It is somewhat unexpected to find this character, an evidence of considerable specialisation, well developed in all the species of *Synthemis*, except perhaps in *S. cyanitincta*, (Plate vi., fig.5) where the sectors fuse quite close to the arculus. The same species, curiously enough, shews the greatest specialisation in the recession of the hindwing-triangle!

*Anal loop.*—The form of this area is of the greatest importance to a correct understanding of *Synthemis* wing-venation. The ten figures of portions of wings of different species (Plate vi., figs.1-10) are arranged in order of development of their anal loops. In *S. olivsei* (fig.1) we have a scarcely formed loop of six cells; in *S. flavoterminalis* (fig.2) the same six-celled loop is very distinctly formed. Six-celled loops occur in several other species, but always in *males* only (see figs.5, 7, 9). A characteristic of the females is that their venation is always more reticulate, and hence the number of cells in the anal loop is greater. In *S. eustalacta* (figs.3 and 4) we have a slightly deeper and larger anal loop, as also in *S. guttata* (fig.6). All these are of *Cordulegasterine* or *Macromia* form. But in *S. regina* ♂ we find a double looping (fig.9), which I find is constant throughout my series, except for one specimen, which has a large single loop. A double loop is also the constant characteristic of *S. macrostigma* ♀ (fig.8), but in this species the two loops are very unequal, a basal loop of 3-4 cells being followed by a distal loop of twice the depth, more than twice the width, and 12 or more cells. In *S. regina* ♀ we have the remarkable form of *three* loops (fig.10), a basal one of 3-4 cells, a slightly larger middle one of 6-7 cells, and a distal one of greater breadth, containing 12 or more cells. These three loops occur in all my *S. regina* ♀ except two; one of which has a small basal loop of four cells, followed by a very large loop of nearly 20 cells (evidently the two other loops fused together), and another has one very large anal loop consisting of all three loops fused together.

This interesting variability of the anal loop throws a strong light on the problem of *Synthemis* wing-venation. If we look at the anal area of the hindwing of an archaic *Aeschnid*, say



*Petalura*, we see that instead of an anal loop there are nearly straight veins descending from various points of the anal vein itself right to the posterior border of the wing. These can still be traced(see fig.10) in several species of *Synthemis*, and they form the sides of the anal loops. Such straight veins are, in one way, lines of weakness in a wing, since they make the posterior margin very liable to tear. How quickly, for instance, does the hind-margin of a *Gomphine* wing wear out! The advantage of the loop is not without many parallels in Nature. A very telling one, it seems to me, can be seen in the difference between the straight veins of the leaves of a monocotyledonous plant and the "archings" of the secondary and tertiary veins in those of a dicotyledonous plant. In the latter no vein that sets out towards the leaf-border reaches it, but arches over on to the next vein; between two arches, another smaller arch will be formed, and so on; the final result being that all border veins run roughly parallel to the margin. Such a leaf is not easily torn or split, whereas a straight-veined leaf splits with great ease. The pressure on the anal area of a dragonfly's wing during flight is probably as great as that of a strong wind on a leaf, and hence the development of loops should be expected, especially in those dragonflies which have a long seasonal range or indulge in long continuous flights. *Petalura*, though of great size, never indulges in long flights. The *Gomphine* have a very short seasonal range, and are seldom on the wing. The necessity, therefore, for the development of loops in these insects has scarcely arisen. But in *Synthemis*, where the seasonal range is quite as long as in most dragonflies (many species that emerge in November last quite to the end of March, and *S. guttata* may be taken right into May), and when the insects are continually in flight whenever the sun is out, the need for wing-strengthening has been much greater. It points, therefore, to very feeble specialisation, that the group has not yet developed a strong and invariable loop, such as is found in *Macromia*.

*Pterostigma*.—A strong braced vein on the edge of the stigma is a sign of high specialisation, and may be seen in the most

advanced genera of many families. In *Synthemis* the stigma is usually unbraced, as in *S. regina* (fig.13), but *S. macrostigma* (fig.15) shows a distinct advance towards bracing, while *S. claviculata* (fig.14) possesses a bracing vein.

*Freak-venation in the Genus*.—I do not recall, in any other odonate genus, such remarkable freak-venation as may be found in *Synthemis*. Especially is this "freaking" to be found in the region of the triangle and arculus. Passing by such small "freaks" as a four-sided triangle, which is especially evident in my series of *S. tasmanica*, n.sp., and *S. cyanitincta*, I come to three remarkable freaks, which I have figured. In the right forewing of a specimen of *S. leachii* ♂ (fig.11), and in the same wing of a specimen of *S. cyanitincta* ♀ (fig.12), I find a freak-variation of the triangle which is of especial interest, as being almost exactly a reproduction of the venation, in this region, of Karsch's remarkable *Pentathemis membranulata*. The venation of that peculiar insect is, apart from the triangle, almost exactly that of an *Aeschnosoma*, and I suggest that the single type-specimen (a female) described by Karsch is nothing more nor less than a freak of that genus. If, in the twenty specimens of *S. leachii* and in the dozen of *S. cyanitincta* taken by myself—both series from the same district, and during the same fortnight—two such freaks could occur, surely it is not a great stretch of imagination to think not only that freaks in single wings are common in this genus, but that a lucky collector might capture one with the *Pentathemis*-triangle in *both* forewings. Whether variation occurs also in *Aeschnosoma*, sufficiently to justify the application of this assumption to that genus, I cannot say; but it seems at least quite possible. Any entomologist who can get access to the *Pentathemis*-type should carefully compare the right and left sides of the insect for any other indication of freaking or variation; and any lack of complete symmetry, especially in the right and left triangles, would go a long way towards establishing my contention that this insect is in reality a freak.

The freak figured in fig.16, from the wing of a male *S. regina*, is so extraordinary, that I doubt if the different veins can be

singled out at all. I figure it simply to show to what extraordinary lengths variation may go in this unstable genus.

To sum up, I think the following conclusions may be fairly deduced from the study of *Synthemis* wing-venation :—

*Synthemis* is an archaic form, evolving along *Macromia* lines (as regards venation). Variation and “freaking” are rampant in the group, shewing that the final and most advantageous form of wing has not yet been attained. The most advanced wing-type in the genus is probably that of *S. claviculata*, with its braced pterostigma and scarcity of cross-veins. *S. cyanitincta* shews a strong tendency to assume the truly *Corduline* property of a recessed triangle in the hindwing. The oldest forms are probably those with abundant cross-veins, such as *S.*

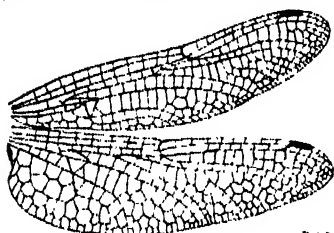


Fig. 1—Wings of *Synthemis claviculata*( $\times 2$ ). *miranda*, *S. regina*, and *S. macrostigma*. In these, there is a more primitive condition of the anal loop, which has not yet become consolidated into a single compact *Macromia* loop. These are also three of the largest insects in the genus, though by no means the best fliers. The tendency is towards a reduction in size, as well as a reduction in cross-veins. (I am inclined to regard *S. olivei* as an advanced member of the genus, with traces of *cænogenesis* in the anal loop).

*Synthemis* is essentially different from *Macromia* in that, though following on similar lines of development, it is in a far less complete and specialised stage.

In his new work on the *Libellulinae*, Dr. Ris has divided that subfamily into groups having great phylogenetic value. He places at the beginning of each group the most archaic genus still extant, which contains the essential characteristic of that group, and leads up to the most highly specialised genus in the same group. The result is a series of groups containing widely different forms, but giving a classification undoubtedly of more educational

value than the usual "linear" grouping of genera. If an attempt be made to unravel the phylogeny of the *Corduliinæ* on the same lines, the genus *Synthemis* might either be placed at the base of the *Macromia* group, or it might be deemed worthy of a separate group, in which the genera to be proposed as subdivisions of it in this paper will also be found to be of distinct phylogenetic value.

Let us now turn our attention to the larval forms of *Synthemis*, the discovery of which should, I think, supply us with evidence of at least coordinate value to that of the wing-venation. (Descriptions of the larvæ of five species of *Synthemis* will be found below, pp. 340, 348, 355, 363, 370.)

The line of specialisation so well known in *Corduline* nymphs, viz., the rounded and smooth body, somewhat triangular and pointed front to the head, and long spider-like legs, is found developed to its greatest degree in nymphs of *Macromia* and allies. In these nymphs the abdomen is almost circular in outline; the head has developed a prominent frontal horn of pyramidal form; and the legs are exceedingly long. Now if *Synthemis* were really so close an ally of *Macromia* as has been supposed, we should expect a somewhat similar larval development. But the contrast between the nymphs could scarcely be more striking than it is. The nymphs of *Synthemis* are absolutely unlike any other known *Corduline* nymphs. Their principal characteristics are—an elongate-oval body, exceedingly villose; strongly divergent wing-cases; head very square in front, with small prominent eyes projecting from the antero-lateral angles; and rather short, thick legs. The general shape of the nymph, especially the head, recalls at first sight the *Orthetrum*-group of larvæ in the sub-family *Libellulince*. But as these two groups are quite distinct in such important characters as the labium and form of wing-cases, it is probable that a great deal of superficial resemblance is simply due to the convergence of adaptive characters, brought about by similar conditions of living.

The nearest ally to the larva of *Synthemis* is most certainly that of the European and American genus *Cordulegaster*. Thanks

to the kindness of Dr. Ris, I have been enabled to study, from his own excellent photographs, the nymph of *Cordulegaster annulatus*, the commonest European species. The resemblance between it and the nymph of *Synthemis eustalacta*, for instance, is extraordinarily close. In both nymphs the head is of the same shape, with square front, prominent eyes, and rounded hind-lobes; the wing-cases of both are strongly divergent; the legs of both are much shorter, in proportion to the size of the larvæ, than in any *Corduline* nymph; the abdomens of both are villous, elongate-oval, and rather rounded than flat underneath. In general appearance the *Synthemis* nymph is shorter and broader—more thickset—than the *Cordulegaster* nymph; but this is almost the only difference.

In *Cordulegaster* the antennæ are seven-jointed, with two basal joints thickened and rather rounded, the other five being filiform. The same is true of the antennæ of *Synthemis* (see Plate viii., fig. 4), which are also very hairy. (I cannot say, from the photos, whether those of *Cordulegaster* are also hairy, but it is highly probable in so villous a nymph).

A comparison of the labia of the same two nymphs shews that both are of the recognised *Corduline* form, with subtriangular mentum, broad lateral lobes, furnished with a terminal spine, and strongly dentate along the distal border. Large setæ are also developed both on the mentum and on the lateral lobes. The dentition of *Synthemis eustalacta* (see Plate ix., fig. 1) is much smaller and more regular than that of *Cordulegaster*, the nearest approach to which may be seen in *Synthemis macrostigma* (Plate ix., fig. 3). In the position of rest, the labium is similar in both, the mentum and lateral lobes forming together a large cup-shaped or almost hemispherical cover to the underside of the head (see Plate viii., fig. 3).

This remarkable similarity between the nymphs of *Synthemis* and *Cordulegaster* is of great phylogenetic importance, for it supplies the missing link between the two great divisions of the *Anisoptera*—the *Æschnidæ* and *Libellulidæ*. Of the *Æschnidæ*, *Cordulegaster* alone—shewing no trace in its imaginal develop-

ment of any *Libellulid* connection—yet possesses this remarkable nymphal labium of distinct *Libellulid* form, and distinctly non-*Æschnid* in every particular. We now find that *Synthemis*, which in its imaginal development is absolutely *Corduline*, without a single *Æschnid* characteristic, possesses a larva exceedingly similar to that of *Cordulegaster*. The gap, therefore, between the two large families is in this way completely bridged. If we place the genus *Synthemis* at the end of the *Libellulidæ*, in the subfamily *Corduliinæ*, and begin the *Æschnidæ* with *Cordulegaster*, we have a very good linear connection between the two. Further, if we see in *Synthemis* and *Cordulegaster* two of the most archaic survivals in the whole of the *Anisoptera*, it is to be expected that such forms would shew small divergence compared with the larger and more specialised groups.

*The Larval Gizzard.*—Dr. Ris has pointed out to me the great importance of the form of the larval gizzard as a character for the systematisation of large groups. In dragonfly nymphs the gizzard is a well-developed organ, lying within the first or second segment of the abdomen, and furnished on its inside with a set of four or more chitinous plates or “folds,” carrying an armature of strong hard teeth for the reduction of the food-masses. In the *Anisopterid* families two main lines of development are found, viz., (1) the *Libellulid* form, which possesses four plates arranged in bilateral symmetry, i.e., one pair of one form, and one pair of another; and (2) the *Æschnid* form, in which the four plates are radially symmetrical, i.e., all alike in form. Dr. Ris found an almost exactly similar pattern in all the *Libellulid* nymphs he examined, both of the *Libellulinae* and *Corduliinæ*. But in the *Æschnidæ*, where a fair number of archaic forms have been placed, the radially symmetrical development differs considerably in the various subfamilies.

I have carefully examined the gizzard of *Synthemis austalacta*, of which a diagram is given below, in Text-fig. 2. The diagram was prepared by cutting the gizzard open longitudinally, spreading it out carefully on a glass slide, and placing another lightly above it; so that the teeth are not absolutely flattened, but are viewed,

as it were, in half-profile. In each of the two inner\* folds will be found two large sharply hooked teeth; in each of the two outer ones, there is a thick single tooth, also sharply hooked, but with

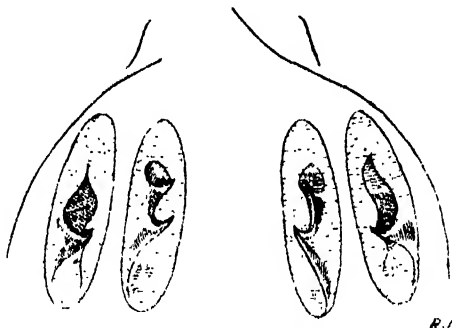


Fig. 2—Larval gizzard of *Synthemis eustalacta* (x 25).

a strong outer lateral edge carrying four or five small serrate teeth, and indications of two very small serrations on the inner lateral edge. For comparison, I examined the gizzards of two other *Corduline* larvae, *Cordulephya pygmaea* and *Hemicordulia tau*; and one *Libelluline* larva, *Orthetrum caledonicum*. They are all almost exactly like that of *Synthemis eustalacta*, the only difference being in the number of small serrations along the edges of the single tooth. This is a very interesting result, for it proves, beyond all doubt, that the larva of *Synthemis*, though so closely allied to that of *Cordulegaster*, is still of the true *Libellulid* stock.

Another point of great interest is that in the larva of *Cordulegaster*, although the *Æschnid* radial symmetry is already established, yet the dentition in each of the four "folds" is very much like that of the two outer folds in *Synthemis*, viz., a single strong tooth with a serrate edge. This is very unlike the dentition in any other *Æschnid* group so far examined; in all of which

\* The terms "inner" and "outer" refer only to the diagram; the line of section might have been taken in a diametrically opposite position, and then the positions would have been reversed; or another cutting might have given us one pair on each side.

the teeth are much reduced in size, possessing no serrate edges, and varying in number from two to nearly thirty on each "fold." This similarity in the dentition of the four folds of *Cordulegaster* with two of the folds of *Synthemis*, helps to convince us further of the close relationship between the two genera. The development of the original *Anisopterid* stock had evidently proceeded but a little way when the progenitors of *Synthemis* and *Cordulegaster* branched off from it; and, most certainly, in their larval forms, further divergence has been very limited, though in the imagines the process of evolution has effected considerable separation.

The lines of divergence of the two main groups of *Anisoptera*, viz., the *Libellulidæ* and *Æschnidæ*, can be roughly indicated by a phylogenetic diagram (text-fig. 3). In this diagram the five sub-families at present dominant, representing the five lines of highly successful specialisation of one kind or another, are arranged at the top, while the remnants of the archaic groups (which we may

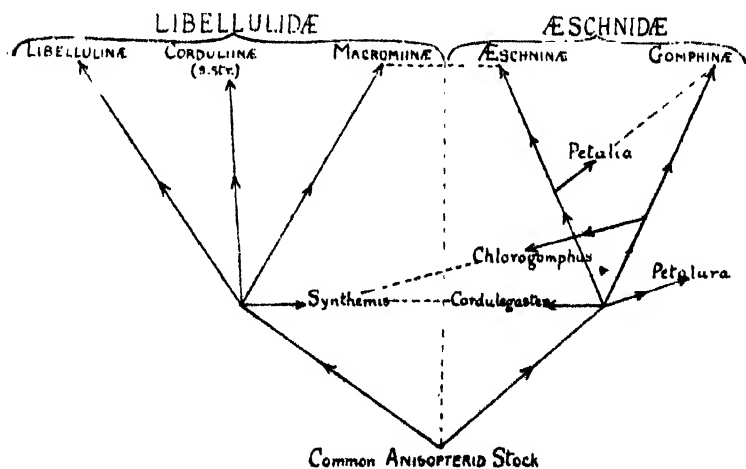


Fig. 3—Phylogenetic Diagram.

well believe have been, in their time, also the dominant groups) are arranged lower down. Convergence of origin-lines indicates convergence of the corresponding groups; e.g., I have placed the



line of origin of the peculiar *Chlorogomphus* so as to converge towards *Synthemis*, since it exhibits a remarkable enlargement of the basal area of the hindwing, which, in its retention of cross-veins, and in the form of its anal loop, bears considerable resemblance to *Synthemis*.

Such a diagram is not, of course, intended to exhibit accurately the relative ages of the various archaic groups. These can only be ascertained, if at all, by a careful study of their present-day geographical distribution, coordinated with a knowledge of the requisite geological data.

The result of this study of both nymphal and imaginal characters in *Synthemis* seems to me to demand imperatively a further alteration in the accepted classification of the *Corduliinae* (sens. lat.). There are, in the subfamily, three distinct groups: *Synthemis* with a distinct non-*Corduline* tendency in the nymph; *Macromia* with a distinct non-*Corduline* (*Eschnine*) tendency in the imago; and, finally, the *Corduliinae*, s.str., forming the greater part of the subfamily, in which the true *Corduline* characters of both nymph and imago are developed. I do not suggest the elevation of these three groups into subfamilies, simply because I do not consider that the *Corduliinae* (sens. lat.) can ever be themselves admitted to more than that rank—their *Libellulid* connection is so close and evident. I would therefore suggest a division of the subfamily *Corduliinae* (sens. lat.) into three main groups as follows:—

i. Larvæ with abdomen considerably rounded, but always longer than wide, smooth; wing-cases parallel; head without frontal horn, subtriangular in front, with eyes well behind the level of the front; legs long and slender.

Imagines with (when present) an elongated anal loop, having a more or less distinct longitudinal bisector; triangle of hindwings very often recessed to, or nearly to, the level of arculus; basilar space always free. ....Group *Cordulina*.

ii. Larvæ with abdomen very much rounded, nearly circular when viewed from above, smooth, much flattened; wing-cases

parallel; head with a prominent pyramidal frontal horn; legs long and spider-like.

Imagines with a compact anal loop, very little, if at all, longer than wide; triangle of hindwing *never* retracted towards arculus; basilar space always free. Large insects of strong flight. ....

.....Group *Macromina*.

iii. Larvæ with elongate-oval body, very villose; wing-cases strongly divergent, head square in front, with eyes projecting from antero-lateral angles; legs short, thick, hairy.

Imagines with anal loop never as long as wide; basilar space always reticulated. Insects of rather weak flight.....

..... Group *Synthemina*.

Group i. contains over eighty species; Group ii., nearly fifty; and Group iii., only fifteen. But it is inevitable, in any attempt of this kind, that the most highly developed and successful forms should far outnumber the members of a more archaic group. I do not say, however, that we should rest content with Group i., as it now stands. There may be lines of division of equal value to the others still to be found in that group. In particular, a careful study of the life-history of *Cordulephya* is necessary before we can be content to leave it in the same group as insects of a very different type.

To turn now to the study of the Group *Synthemina*, consisting of the fifteen species of the genus *Synthemis*. Various authors have pointed out the need of some subdivision of the genus, but the attempts made were only tentative, mainly from lack of material to study the group as a whole. Prof. Förster, when describing his new species, *S. primigenia* from New Guinea, noticed the remarkable difference in the female sex-organs of this species and those of *S. brevistyla*. Apparently he had no knowledge of the type *S. eustalacta*. However, he suggests a subdivision into two genera as follows:—

♀. Without ovipositor and conspicuous appendages: 8-10 lying in one straight line; 8 clipped off straight behind. ....

..... *Eusynthemis* (*S. brevistyla*).

♀. With 8 cut off slantingly, 9 and 10 bent upwards, and a long ovipositor. .... *Palæosynthemis* (*S. primigenia*).

He adds a note to the effect that, owing to the great rarity of specimens of *Synthemis* in collections, he cannot classify the other species.

Of course, such a division, from a knowledge of two species only, could scarcely be expected to be of any value for the reception of other species. Let us take, for instance, the type *S. eustalacta*, with which Förster should surely have become acquainted before making his attempt. It possesses an ovipositor, though neither so long nor of so exaggerated a form as that of *S. primigenia*. However, it must go into *Palæosynthemis*. Hence the original type of the genus cannot now be the type of either subgenus.\* Again, *S. regina*, a species very closely allied to *S. eustalacta*, possesses no ovipositor, and would therefore go into *Eusynthemis* with *S. brevistyla*, with which it has very little affinity.

Apart from any other reason, the excessive rarity of the females of these insects is a strong reason for not employing the female sex-organs in generic subdivision. But a study of the ovipositors of the various species will, I think, convince us that they are only of very limited value in this case.

First of all—and this is suggested partly by Förster's diagram of *S. primigenia* ♀—it is necessary to remark that great variability exists in the appearance of the end-segments. Females of *Synthemis*, on emergence, are very flabby, and remain so, in their retirement, for long periods, with not only the three end-segments often imperfectly filled out, but with their whole bodies absolutely flat from lack of food. Even if one is fortunate enough to capture a well-developed female (generally one which has been ovipositing), one finds considerable differences in the position of

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\* See International Rules of Zoological Nomenclature, Art. 29. "If a genus is divided into two or more restricted genera, its valid name must be retained for one of the restricted genera. If a type was originally established for said genus, the generic name is retained for restricted genus containing said type."

segments 9 and 10 with respect to 8. In some specimens, especially ill-nourished ones, segments 9 and 10 are piled up somewhat as in Förster's diagram, but I doubt if it ever is so in a well-fed specimen, even of *S. primigenia*. Though, in all those species possessing an ovipositor, segments 9 and 10 are—seen laterally—much narrower than 7 and 8, yet, in their proper positions, they lie in a line more or less parallel to, and above, the ovipositor. Förster's diagram apparently represents not only an immature, but even a malformed or damaged specimen, for the end abdominal appendages of segment 10 are entirely lacking!

*Variation of the Female Sex-Organs.*—We shall see, from a study of every species of *Synthemis* of which the female is known, that there is an enormous difference in these organs, even in the most closely allied species. There is no doubt that the ovipositor, where still present, has ceased to be used for its original purpose, i.e., no species of *Synthemis* now uses its ovipositor as a terebra or borer. I have watched five species of *Synthemis* ovipositing. Three of these possess well-formed ovipositors—*S. macrostigma*, *S. eustalacta*, and *S. flavoterminalata*. All three lay their eggs in the *Libellulid* manner, by flying close to the surface of the water, then hovering with body almost vertical, and dipping it with short quick movements, three or four times in succession, into the water, so as to wash the eggs out, several at a time. Females of *S. eustalacta*, captured in the act of oviposition, have immediately exuded clusters of eggs from ten to a hundred or more in number. (A portion of one of these clusters is figured, greatly magnified, in Plate viii., fig.1). Females of *S. macrostigma*, however, captured in the same way, exude only two or three eggs in a cluster, and sometimes none at all. These, also, sometimes support themselves by holding lightly to a reed-stem, while still hovering with their wings, and dipping their abdomens in the usual way. *S. flavoterminalata*—and the two species, *S. regina* and *S. guttata*, which do not possess ovipositors—all oviposit while flying rapidly to and fro over the water, and wash out their eggs in large clusters.

Probably the ovipositor—especially when it is curved, as in *S. leachii* (Plate vii., fig. 18)—is still of some use in controlling the escape of the exuding egg-masses. This may account partly for its retention in so many species, long after its original use has gone.

In *S. flavoterminalis*, there is a remarkable variation in the length of the ovipositor, compared with the end-segments, in fully developed females. In Plate vii., figs. 22a, b, and c, are shewn the ends of three females in my collection. At first sight it looks as if the ovipositor was very variable itself in length and shape; but I think that this appearance is due mostly to change in relative position, and that if the ovipositor of fig. 22c could be cut out and measured, it would be very little larger than that of fig. 22a, which projects only half as far. Still, this is evidence of variability of the structure in this species, and it may be that *S. flavoterminalis* is even now in process of losing a structure already somewhat aborted. Another peculiarity in the ovipositor of the same species is, that it carries at its tip a small transparent glutinous mass. This is present in all my specimens (twelve), and therefore is not likely to be a remnant of the sticky substance which holds the eggs together. Its use appears to be to supplement the short ovipositor in holding the egg-masses back from too rapid exudation.

I have figured in Plate vii., the end-segments of the females of eight species. Next to *S. primigenia*, the longest ovipositors are possessed by the four species *S. macrostigma* (fig. 17), *S. leachii* (fig. 18), *S. eustalacta* (fig. 19), and *S. tasmanica* (fig. 20). These represent the most primitive form of the organ still existing in Australia. We then have in *S. flavoterminalis* (fig. 22) a considerably shorter and more aborted ovipositor. Passing on, we come to *S. regina* (figs. 16a and b)—a species very closely allied in other respects to the *S. eustalacta*-group—with only a small remnant of an ovipositor left; *S. cyanitincta* (figs. 21a and b) with a still smaller remnant; *S. claviculata* (not figured) with a similar tiny remnant; and finally, to the closely allied group of four species, *S. brevistyla*, *S. virgula*, *S. guttata*, and *S. nigra* (see fig. 23), in

which the ovipositor has completely disappeared, leaving the ninth segment hollow without any prominent covering from the underside of 8.

It thus appears that the female sex-organs are, in this group, too variable to be of much use in generic separation. The group of four species last-mentioned is the only one in which I propose to use it as a generic character.

*Male Sex-Organs.*—Throughout the group the primary sex-organs of segment 2 are not prominent, the sheaths being fairly large and well-rounded and forming an effective protection to the penis, which is deeply recessed between and below them(see Plate vii., fig.15). The form of the penis itself is probably only of specific value, varying, no doubt, considerably with the variation already described in the female sex-organs. In any case, as the specimen has to be sacrificed in order to examine it, it is inadvisable to use it in classification. However, I have figured the penis of three species typical of the three genera into which I propose to subdivide the group. The general shape is somewhat the same in all three; but in *S. eustalacta*(fig.24) there is a long curved filament projecting from the base, followed by a row of hairs decreasing in size; in *S. guttata*(fig.25) this filament is absent, and the hairs are more numerous, but shorter; in *S. flavoterminalata*(fig.26) the filament is absent, and the hairs few. On the upper part, *S. eustalacta* possesses a long curved filament similar to that on the base; *S. guttata* a shorter one, nearly straight; and *S. flavoterminalata* the merest rudiment of one. I have been unable to spare specimens from the rarer species to carry this investigation further; nor do I think it of much value towards forming a really *useful* classification of the group.

We now turn our attention to the secondary male sex-organs, i.e., the anal appendages of the abdomen, used as claspers in holding the female. These are figured for every species (except *S. miranda*, of which the male is unknown) in Plate vii., figs.1-14. We find here three distinct groups, each of which is associated with a corresponding form of the abdomen. In the first group (figs.1 to 8), the superior appendages are long, and more or less wavy; the corresponding abdomen is pinched at segment 3 or 4,

enlarged at 6 and 7, and slightly pinched again at 8-9 (except in *S. cyanitincta*, where 7-9 are uniformly broad). In the second group (figs. 9-12) the superior appendages are very short, and slightly forcipate; the corresponding abdomen is shorter, not very pinched at 3-4 (except *S. nigra*). In the third group (figs. 13-14), the superior appendages are of medium length, slender and straight; the corresponding abdomen is exceedingly slender and cylindrical. (In the coloured Plates, figs. 1-7 belong to group 1, 8-11 to group 2, 12-13 to group 3; *S. nigra*, fig. 9, has an abdomen varying in shape, but the most slender specimen has been figured in order to contrast more strongly with *S. guttata*, fig. 8).

As already shewn, there is very little in the wing-venation which is really constant enough to be of value in subdividing the genus. There is, however, one character, not yet mentioned, which seems to me to be of considerable importance, and that is the form of the membranule in the hindwing. Nearly all *Corduliinae* possess this membranule as a rather narrow, elongated, and often darkened, membrane at the base of the anal vein; in the male reaching some distance along the border of the anal triangle; in the female attached to the corresponding curved anal border. Now in the two species *S. flavoterminalata* and *S. olivei*, the membranule is so reduced as not to be visible to the eye, and the anal triangle of the male has developed a slight convexity of its outer border, instead of being slightly concave, as it is when the membranule is present. These two species form group 3 above-mentioned. So that, with their slender bodies, thin straight appendages of medium length, and this peculiarity in wing-venation, they are sufficiently distinct from the main body of species to warrant a new generic name. There is also another important difference between them and the rest, and that is the size of the front of the head, which is only about half the width of that of any of the remaining species. I propose, therefore, on the strength of these characters, to separate out *S. flavoterminalata* and *S. olivei*, and to place them in a new genus, *Choristhemis*.\* The type of this genus will be *S. flavoterminalata* Martin.

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\* Greek *χῆσις* without, in allusion to the absence of membranule.

In studying the remaining thirteen species, we can at once pick out a homogeneous group of four (group 2 above-mentioned) characterised by the short anal appendages of the males, the absolute loss of the ovipositor in the females, and the generally rather shorter and less constricted abdomen. These are *S. brevistyla*, *S. virgula*, *S. guttata*, and *S. nigra*. I regard these as the most advanced members of the group *Synthemis*. Their venation is more open and less inclined to variation than that of the other species, and in the complete loss of the ovipositor, they have at last reached an invariant stage. These four species are also very much more closely allied to one another than any other two species outside them. I therefore propose to place them in a new genus, *Metathemis*, of which the type will be *S. guttata* Selys.

There now remain nine species (including the imperfect female-type, *S. miranda* Selys, which is retained next to *S. regina*, to which it is closely allied in venation), in which the superior appendages of the male are always long and wavy, the membranule always present, the front large, and the abdomen long, pinched at 3-4, and (except in the smallest species, *S. cyanitincta*) somewhat narrowed again at 8 or 9. Of these, the female of *S. primigenia* possesses an enormously long ovipositor; the ovipositors of *S. eustalacta*, *S. tasmanica*, *S. leachii*, *S. macrostigma* are large and conspicuous; that of *S. regina* (closely allied in other respects to *S. eustalacta*) is very small and those of *S. claviculata* and *S. cyanitincta* almost obsolete. The two latter are otherwise not by any means closely allied, and are from widely different localities. Of all the species it may be said that, in contrast to the four species above separated out, they all possess *at least a rudiment* of an ovipositor. I propose to retain these in the genus *Synthemis* (restricted), the type of the restricted genus, of course, remaining *S. eustalacta* Burm., the original type of the whole genus proposed by de Selys.

I cannot see any advantage in suggesting further subdivision. The nine species just considered form, without doubt, a less homogeneous division than the other two, but they are in many ways very closely allied, and are certainly the most archaic members of the group still extant.



There is also a corresponding difference between the larval forms (so far as they are known). The nymph of *S. flavoterminalata* is small and of rather slender build, with a small projecting frontal *rectangular* plate, fringed with small hairs; that of *S. guttata* is of stouter build, and has a much larger almost *semicircular* projection or plate standing out from the front; those of *S. eustalacta*, *S. macrostigma*, and *S. regina* are of stout build, but possess only a row of hairs on the front and not a projecting plate (see Plate viii., fig. 2, *S. eustalacta*; fig. 5, *S. guttata*). The four species comprising the genus *Metathemis* are so closely allied, that I have no doubt this frontal plate will be found in the nymphs of the other three, and will form an excellent generic diagnostic for the larval forms.

4 The classification proposed may now be exhibited as follows:—

- |    |   |  |                            |
|----|---|--|----------------------------|
| 1. | { | Front small, abdomen narrow cylindrical, membrane absent .....   | <i>Choristhemis</i> , n.g. |
|    |   | Front large, abdomen of variable width, membrane present .....   | 2.                         |
| 2. | { | Superior appendages of male short; female without ovipositor .....                                       | <i>Metathemis</i> , n.g.   |
|    |   | Superior appendages of male long and wavy; female with, <i>at least</i> , a rudimentary ovipositor ..... | <i>Synthemis</i> (s.str.). |

And, for the nymphs :—

- |    |   |   |                            |
|----|---|---|----------------------------|
| 1. | { | Small nymphs of slender build; front with a small projecting <i>rectangular</i> plate, fringed with small hairs ..... | <i>Choristhemis</i> , n.g. |
|    |   | Larger nymphs of stouter build .....  | 2.                         |
| 2. | { | Front with a conspicuous <i>semicircular</i> projecting plate .....   | <i>Metathemis</i> , n.g.   |
|    |   | Front without a plate, but with a row of hairs .....  | <i>Synthemis</i> (s.str.). |

I now pass to the systematic description of the species, arranged in the proposed genera. Where the life-history has been studied, the details of it and the description of the nymph are given under each species. The descriptions of the imagoes are taken from freshly killed specimens, and are made as short as is consistent with a full determination of specific differences.

## Subfamily CORDULIINÆ.

Group *Synthemina*.

Imagines of slender build and rather weak flight. Anal loop of hindwing of compact form, never as long as wide; basilar (median) space always reticulated. Larvæ with head squarish in front, eyes projecting from the antero-lateral corners; legs short and hairy; abdomen elongate-oval in shape, villous; wing-cases strongly divergent; distal margin of lateral lobes of labium distinctly dentate.

Genus 1. *SYNTHESIS* Selys, a me restrictum.

Membranule present, front large, abdomen varying in width, always pinched at 3 or 4 and widening to 7. Superior appendages of male long and wavy. Female with, *at least*, a rudiment of an ovipositor, often with a large and conspicuous ovipositor. Larvæ of stout build, with a row of hairs along front of head, but *without* a projecting flat frontal plate. Type: *Synthesis eustalacta* Burmeister.

Key to Species of *Synthesis*(s.str.).

## Males.

- |    |  |                         |
|----|--|-------------------------|
| 1. | { Thorax with antehumeral spots or stripes.....  | 2.                      |
|    | { Thorax without antehumeral spots or stripes.....   | 3.                      |
| 2. | { Thorax with four creamy antehumeral spots.....   | <i>S. leachii</i> .     |
|    | { Thorax with antehumeral stripes.....   | 4.                      |
|    | { Segment 10 of abdomen with a conspicuous dorsal spine or tubercle.....   | 5.                      |
| 3. | { Segment 10 of abdomen without any dorsal spine or tubercle.....  | 6.                      |
|    | { Antehumeral thoracic stripes yellow; colour metallic black with yellow spots.....  | <i>S. claviculata</i> . |
| 4. | { Antehumeral thoracic stripes pale bluish, short; size of insect small, colour brown with pale bluish spots.....              | <i>S. cyanitincta</i> . |
|    | { Dorsal spine black; conical; size of insect large; colours black and yellow.....   | <i>S. regina</i> .      |
| 5. | { Dorsal spine pale yellow, depressed anally.....  | 7.                      |
|    | { Inferior appendage just under half length of superior; colour pinkish-brown with creamy spots.....                           | <i>S. macrostigma</i> . |
| 6. | { Inferior appendage considerably over half length of superior; colour black with a few tiny yellow spots.....                 | <i>S. primigenia</i> .  |
|    | { Abdomen blackish with bright yellow spots; inferior appendage two-thirds length of superior, truncate                        | <i>S. eustalacta</i> .  |
| 7. | { Abdomen dark brownish with paler yellow spots; inferior appendage slightly over two-thirds length of superior, truncate..... | <i>S. tarmanica</i> .   |

(N.B.—The male of *S. miranda* Selys, is unknown.)

**Females.**

- |    |  |                         |
|----|--|-------------------------|
| 1. | { Four to five cross-veins in basilar space, eight to nine in submedian.....   | <i>S. miranda</i> .     |
|    | { Not more than four cross-veins in basilar space, nor eight in submedian.....   | 2.                      |
| 2. | { Segment 8 with a conspicuous ovipositor.....   | 3.                      |
|    | { Segment 8 without a conspicuous ovipositor.....  | 4.                      |
| 3. | { Ovipositor very long, reaching beyond end of segment 10. ....  | <i>S. primigenia</i> .  |
|    | { Ovipositor not reaching beyond end of abdomen.....   | 5.                      |
| 4. | { Thorax with a pair of antehumeral stripes.....   | 6.                      |
|    | { Thorax without antehumeral stripes; colour black and yellow.....   | <i>S. regina</i> .      |
| 5. | { Thorax with four antehumeral creamy spots.....   | <i>S. leachii</i> .     |
|    | { Thorax without antehumeral stripes or spots.....   | 7.                      |
| 6. | { Thoracic antehumeral stripes yellow; colour metallic black and yellow.....   | <i>S. claviculata</i> . |
|    | { Thoracic antehumeral stripes pale bluish or creamy, short; size of insect small.....   | <i>S. cyanitincta</i> . |
| 7. | { Lateral thoracic stripe entire.....  | 8.                      |
|    | { Lateral thoracic stripe broken into a rounded and an elongated spot; colour pinkish-brown with creamy spots.....                         | <i>S. macrostigma</i> . |
|    | { Appendages in profile rather oval and flat; colour of abdomen blackish with yellow spots.....  | <i>S. eustalacta</i> .  |
| 8. | { Appendage in profile narrower and more cylindrical; colour of abdomen dark brown with paler yellow spots; insect smaller than above .... | <i>S. tasmanica</i> .   |

**1. SYNTHEMIS EUSTALACTA Burm. (Plate iv., fig. 1.)**

Burmeister, Handbk. Entom. Névropt. 1839: Selys, Bull. Acad. Belgique, xxxi. 1871; xxxvii. 1874.

♂. Total length 51 mm., abdomen 38 mm., hindwing 32 mm.

**Wings:** *Costa* yellowish outwards, *pterostigma* 2.5 mm., dark brown between black nervures; *membranula* 2 mm., dull grey. Three cross-veins in basilar space, 4-5 in submedian space; all triangles usually free. **Head:** *Eyes* brilliant greenish (when alive), bordered with dark brown, a pale yellow patch behind; *vertex* hairy, black; *front* hairy, cleft medially, pale yellow above and on sides, brown on face, black in median cleft; *postclypeus* brownish, a yellow spot on each side; *anteclypeus* brownish, touched with pale yellow; *labrum* yellow edged with brown; *labium* pale yellowish-grey, mouth edged with dark brown.

**Thorax:** *Prothorax* small, dark brown, a yellow collar in front, a triangular yellow spot behind. *Meso-* and *metathorax* deep rich chocolate-brown, a yellow line along dorsal ridge; on either side of it a broad straight steely metallic band; a small bright yellow spot at each wing-base. Sides of thorax with a broad yellow band, bordered above by a narrower steely metallic band; low down, two yellow spots of fair size; *notum* brown with yellow scutella. **Abdomen** subcylindrical, pinched at 3, broadening to 8; 9-10 narrower. Colour rich black, marked with pale bright yellow as follows—1, a dorsal spot and two small lateral spots; 2, auricles yellow, a slanting spot on each side of dorsum; 3, basal half yellow with a somewhat diamond-shaped black dorsal mark, rest black. Segments 4-7 with a pair of small basal spots, a pair of larger central spots, smallest on 6, larger and of irregular shape on 7; 8 three-fourths covered by a pair of large bright yellow spots, almost meeting along dorsum; 9 with two small basal spots; 10 with a conspicuous pale yellow spine, bent over anally, sharply pointed. **Appendages:** *Superior* 3.2 mm., slightly wavy, converging at tips, which are blunt and rounded, almost black; *inferior* two-thirds as long, truncate, bent upwards. (Plate vii., figs. 1a, b).

♀. A slightly larger and duller insect; wings often tinged with pale brown or yellow, pterostigma 3 mm., pale brownish. *Head* and *thorax* as in male; abdomen stouter, cylindrical; 2 with large oval spots; 3 as in male; 4-7 with larger basal spots and with central oval spots decreasing in size, *smallest* on 7; 8, rather short above, with two small basal spots; 9-10 without spot. *Ovipositor* 2 mm., reaching to below 10, conspicuous; appendages 1.2 mm., straight, somewhat flat and oval when viewed sideways, blackish. (Plate vii., fig. 19.)

**Types:** Coll. Germar, Coll. Selys, ♂♀.

**Hab.**—New South Wales, Victoria, and South Australia.

Common on bogs and marshes, and sometimes on small running streams, in mountainous districts. Females very rarely seen, in comparison with males.

*Life-History of S. eustalacta.*

The perfect insect emerges about the beginning of November, and continues on the wing until March. Pairing takes place from the middle of November onwards, but it is always difficult to find either pairs in flight or females ovipositing. On a small swamp at Laura, Blue Mountains, where the insect is common, I have watched the female ovipositing in December. When pairing, the male seizes the female in the usual way with his anal appendages, clasping her round the prothorax, with the inferior appendage bent forward over the front of the prothorax. In this position they usually indulge in a wild up-and-down flight, finally flying away into the bush. When a female appears on the swamp there is usually more than one male ready to pair with her, and often quite exciting scuffles occur before pairing is effected. Pairs are also frequently heckled by single males, which sometimes succeed in separating them.

When the female is ready to deposit her ova, she returns to the swamp, flying low, and keeping as much as possible out of the main track of the numerous males flying up and down. However, when she chooses to oviposit right in the track of their flight, they seldom molest her. The place chosen for the eggs is always the same, viz., in still water of from a few inches to a foot or two in depth, overlying deep mud, and close to the main water-drainage of the swamp. If one dredges such places in the early spring, larvæ of *S. eustalacta* will be found in abundance, but no larvæ of any other species.

Although the female possesses a conspicuous ovipositor, it is apparently of no use to her except perhaps in controlling the exit of the egg-masses. She flies close to the water, along the edges of the reed-beds, continually dipping the tip of her abdomen into the water, so as to wash out the eggs, which fall down and settle on the mud. This is done in characteristic fashion, with the abdomen held nearly vertical and brushed forward at each dip, so as to touch the water gently. Sometimes the action appears to be done easily and not hurriedly, but at other times---

particularly when a storm is brewing—I have seen it carried out in great haste, and apparently in considerable trepidation.

A female captured by me, during oviposition, immediately exuded a large cluster of small oval yellow eggs, over a hundred in number. Portion of this cluster is shewn on Plate viii., fig. 1. Other females have exuded smaller clusters, and sometimes none at all. There is no doubt that they can be persuaded to wash out ova into a tube of water, while being held in the hand. Unfortunately I was unprovided with one at the time mentioned, so that I have had no opportunity of hatching eggs of this species.

On dredging the swamp late in December, I have found a few very small larvæ, as well as a few fully fed ones not yet emerged. Hence I conclude that the ova hatch out in from two to three weeks (the usual period in the case of other *Corduline* ova which I have hatched). The larvæ evidently grow rapidly and are full fed within the year. I have taken larvæ in September only half-grown, which, fed up in my aquarium, have emerged before Christmas.

The young larva, which is very hairy, lies nearly buried in the soft mud. In the aquarium, where they are supplied with fine sand, larvæ of all sizes throw up the sand all over them, and scoop out in the process a depression into which they settle, leaving just a slight outline of the body visible, and their eyes and the top of the labium. I am not at all impressed with the power of the labium as a weapon of offence. It is so short in its reach that an insect would have to come very close up to it before it could be captured and eaten. I think that insects and other small water-animals are very seldom captured in this manner, but that often the large cup-shaped labium is used to draw in a large quantity of muddy water, which is then sifted and examined by means of the numerous setæ and the terminal hook, and thus a considerable quantity of minute food is obtained.

In one jar I kept a nearly fullgrown larva without food for some weeks. He never moved his position once. I then introduced, all at once, about two hundred mosquito larvæ. As these

wriggled past him, he snapped at them again and again. At every three or four tries only, he succeeded in catching one. But so eagerly were they devoured that he accounted for nearly fifty in the course of ten minutes. After that he continued to snap at them occasionally, without apparently any further desire to eat them.

These larvæ are very clumsy, but are capable of running fairly quickly when they have dragged themselves free from most of the surrounding mud. When full-fed, they crawl about on the surface of the mud or sand for days, being all the time only partially covered with mud. They seem quite unable to ascend a stick or stem rising from the water, but crawl out into the sedge or grass first, probably to get drier. Finally they ascend a stem in a most clumsy manner, and emerge in all sorts of curious positions—bent sideways, twisted nearly double, and often nearly upside down. In my aquaria, larvæ would continually get out over the side, and crawl far away into a corner of the room; so that sometimes I found the newly emerged insect on the window-curtain, and never found the exuviae at all. Others failed to emerge, and the dead bodies of the larvæ were found hidden in all sorts of localities. Only a very few ascended the sticks placed against rocks or wood in convenient positions for them.

Taking the nymphs at random, I have bred an almost equal number of both sexes, the females being slightly more abundant. This shews that the rarity of the female on the swamps is due only to her retiring habits.

The general characters of the nymphs of *Synthemis* having already been indicated, I now pass to the detailed description of the ovum and the full-fed nymph.

**O v u m** about 1 mm. long, by 0.8 mm. broad, spheroidal, very slightly pointed at the upper end where it is attached to the main egg-mass. Colour yellow, darkening to orange on exposure to air, and becoming less transparent (Plate viii., fig. 1).

**N y m p h** (fully grown): total length 21 mm., abdomen 15 mm.; width of head 5 mm.; wing-cases 6 mm. long; antennæ 2.7 mm. Colour dark brown; very hairy (Plate viii., fig. 2).

Head square in front, with small prominent dark eyes at the extreme antero-lateral corners; *front* fringed with a ridge of irregular hairs; *antennae* seven-jointed (Plate viii., fig. 4), first and second joints from base short, stout and rounded, next four longer and narrower, cylindrical, with pale tips; seventh (apical) joint thin, sharply pointed; all segments furnished with irregular hairs of varying lengths, and great fineness; *ocelli* inconspicuous, in a small triangle on the rather flat epicranial surface; *postocular lobes* full and well-rounded, hairy. The back of the head is of irregular surface, so that mud and silt collect in ridges there, giving the appearance, shewn in the Plate, of a slight colour-pattern of light and dark brown alternately. (View of head from in front is given in Plate viii., fig. 3). *Labium*, in position of rest, reaching to between the bases of middle and hind legs; length, when closed, to base of mentum, 6.5 mm.; median and lateral lobes of mentum when closed forming a nearly hemispherical cup fitting close up to eyes and antennae; rest of mentum projecting backwards more flatly; indentations of lateral lobes fitting closely, and terminal hooks lying concealed along margin; length of mentum 3 mm., greatest breadth 4.5 mm.; lateral lobes 1.8 mm. to base of terminal hook. *Mentum* broad, subtriangular, with median lobe advanced to a blunt rounded apex; mental setae, 5 primary, about 1 mm. long, 4 secondary, 0.2 to 0.3 mm. long, on each side. *Lateral lobes* subtriangular, outer edge strong, ridged, with tiny stiff bristles arranged irregularly along outer edge; five strong stiff *lateral setae* springing from the inner side of the ridge, from 1.2 to 0.8 mm. long; *terminal hook* just above the top seta, very sharp, 1 mm. long; *distal border* strongly dentate, there being generally *seven* distinct teeth on each side, unsymmetrical, but arranged so as to fit one another accurately when the mask is closed; teeth rounded, the larger ones tending to overhang slightly on the lower side ("nodding"); largest tooth, generally the middle one on the left-hand side, about 0.3 mm. broad by 0.2 mm. high (Plate ix., fig. 1). *Thorax*: *Prothorax* short and broad, with protruding lateral angles. *Meso-* and *metathorax* well-formed, fairly smooth, dark brown



above, paler beneath, especially around the coxæ. *Legs* of medium thickness, rather short; lengths of femur, tibia, and tarsus respectively are—foreleg 3.3-1.7 mm.; middle leg 5.4-5.2 mm.; hindleg 6.5-5.3 mm.; coxæ pale, femora dark brown, somewhat hairy, tibiæ dark brown, with longer and finer hairs, tarsi 3-jointed, with a few small hairs, ending in two rather small weak hooks. *Wing-cases* flat, hairy, *strongly diverging from bases*, so that their tips reach the level of the middle of the sixth abdominal segment, and rest, projecting very slightly from each side of abdomen; forewing-case placed so completely under that of hindwing that only a small portion along the costa is visible. *Abdomen* elongate-oval, well rounded above, fairly rounded beneath; broadest at segment 6, then tapering rapidly to end, which appears somewhat pointed; no colour-pattern, but the transverse sutures between the segments are rather deeply set under a raised apical ridge of large and conspicuous hairs, giving the body an exceedingly villous appearance, and causing the mud to adhere to it in great quantities: caudal appendages, superior 1.6 mm., sharply pointed, curving slightly downwards; two inferior 1.8 mm., straight, pointed; two smaller laterals, 0.8 mm.; all rather hairy.

*Types*: Coll. Tillyard (Leura, Blue Mountains).

## 2. SYNTHERMIS TASMANICA, n.sp. (Plate iv., fig.2.)

♂. Total length 45 mm., abdomen 34 mm., hindwing 28 mm.

*Wings*: *costa* yellowish outwards, *membranule* 2.5 mm. long, whitish, *anal triangle* with a tiny cross-nervule very low down, *pterostigma* 2.5 mm., pale brown between dark nervures. *Head*: *eyes* greenish in the living insect, bordered with dark brown, with a pale yellow mark behind; *vertex* small, dark brown; *front* cleft medially, pale yellow above and on sides, rich brown in front; *clypeus* pale glaucous-brown in centre, livid grey on sides, a livid spot in centre of anteclypeus; *labrum* and *labium* shining livid grey, faintly tinged with purple. *Thorax*: *prothorax* brown, a narrow collar in front, and a dorsal spot, both pale yellow. *Meso-* and *metathorax* rich dark brown, a yellow

line on dorsal ridge, edged on both sides by a broad metallic black band; on each side a straight lateral band of pale yellowish colour, enclosing the mesospiracle, bordered above by a shorter and narrower band of metallic steely black; low down, two conspicuous oval yellowish spots; *legs* black, underside of profemora partly yellowish; *notum* brown with yellowish scutella; a conspicuous pale yellow spot at each wing-base. *Abdomen*: 1-2 enlarged, 3 pinched at base, then widening to 7, 8-10 slightly narrower. *Colour*: 1, brown; 2, brown, with a slanting pale yellow mark on each side, auricles pale straw-colour, genital opening edged with yellow; rest of abdomen dark brown, marked with pale yellow as follows—3, a pair of semioval basal spots, a pair of larger central spots rather pointed basally; 4-7, with the basal spots smaller, the central spots oval in 4-5, almost round in 6-7; 8 with two very large dorsal spots, oval, separated by a fine dorsal line; 9 with two small round basal spots; 10 dark brown with a small yellowish dorsal spine depressed anally. *Appendages*: *superior* 2.8 mm., black, wavy, approaching one another at tips, which are blunt; *inferior* 2 mm., broadly truncate, upcurved, dark brown (Plate vii., figs. 3a and b).

♀. Similar to male but slightly larger, especially in expanse of wing. Total length 42 mm., abdomen 31 mm., hindwing 30 mm., pterostigma 2.8 mm.

*Head and thorax* as in male. *Abdomen* thicker than in male, almost cylindrical, tapering slightly from base to apex. *Colour* dark brown spotted with pale yellow as follows—2, a small basal point low down on each side, a pair of round central spots; 3-7, a pair of semioval basal spots, a pair of larger oval dorsal central spots nearly touching; basal spots decreasing in size from 3 to 7, being mere specks on 7; 8-10 very short, 8 with a pair of small oval basal spots, 9-10 with a transverse narrow band in sutures. *Ovipositor* conspicuous, reaching to end of 9, dark brown, tip fairly wide and blunt; *appendages* 1.5 mm., straight, cylindrical, with rounded tips, dark brown, separated by a rounded projection of 10 which carries a small tuft of hairs (see Plate vii., fig. 20).

*Type-series*: Coll. Tillyard, ♂♀ (St. Patrick's River, Tasmania).

*Hab.*—Northern Tasmania. I took it at St. Patrick's River, Launceston, and Cressy, in December, 1908, and January, 1909. I did not find it in Southern Tasmania.

The type-series was taken along the swiftly-running mountain-stream, where, no doubt, the larvæ lived. At Launceston and Cressy the insects were found inhabiting swamps—localities similar to those frequented by *S. eustalacta* on the mainland.

This species is the Tasmanian representative of *S. eustalacta*, the latter not being found in the island. Differentiation from the parent-stock has proceeded far enough, in my opinion, to justify the separation of the island-form as a separate species. Apart from its very much smaller size and duller colouration—characters which in themselves make the two species easily distinguished at a glance, though of little morphological value—there is a constant difference in the appendages of both sexes. In *S. eustalacta* ♂, the inferior appendage is just about two-thirds as long as the superior; that of *S. tasmanica* ♂, is larger by comparison, and somewhat more truncate. In *S. eustalacta* ♀, the appendages are more leaf-like and less cylindrical than in *S. tasmanica* ♀; also the ovipositor of the latter is shorter and more upcurved than that of the former; these differences are clearly shewn in the diagrams of Plate vii. (compare figs. 1 and 2, and figs. 19 and 20).

The colour-scheme of the St. Patrick's series, when alive, was rich chocolate-brown with pale yellow spots. So different were they from all *S. eustalacta* I had ever taken, that I never connected the two species until, on examination, I found the depressed dorsal spine on segment 10 of the male. Later, when I took specimens flying on swamps at Launceston and Cressy, I noticed that these had more the colouring of typical *S. eustalacta*. It seems, therefore, that the duller colouration is brought about by a change of living, from stagnant to running water. This is also the case with other members of the group; the brilliantly coloured *S. macrostigma*, *S. regina* and *S. eustalacta* are dwellers in slow or stagnant water, while the duller *S. leachii* and the darkly coloured *Metathemis* subgroup live in running streams.

In the coloured plate, the differences of colouration are very carefully shown, and the two species placed side by side for comparison of size also.

3. *SYNTHESIS REGINA* Selys. (Plate iv., fig.3).

Selys, *loc. cit.* 1874.

♂. Total length 57-60 mm., abdomen 45-47 mm., hindwing 33 mm.

Wings: *costa* pale yellowish outwards; *ptero stigma* 2 mm., black, *membranule* 2 mm., narrow, whitish. Head: *eyes* deep green in living insect; *vertex* black; *front* hairy, cleft medially, yellow above, marked with a broad black T-mark, the stem of which lies in the median cleft; face of front black, surrounded above and on sides with yellow, the black centre being nearly rectangular; *clypeus* pale yellow; *labrum* black, with a pair of pale yellow or creamy spots separated by a black bar; *labium* pale dirty flesh-colour, *genae* black, *mouth* edged with black. Thorax: *prothorax* black, a yellow collar in front, a large yellow mark behind. *Meso-* and *metathorax* black or very dark brown with deep metallic bluish or greenish reflections; a conspicuous yellow line along dorsal ridge; *no dorsal bands*. On each side a broad band of lemon-yellow enclosing the mesospiracle; below this a narrower band of the dark ground-colour, rest of sides bright yellow; *legs* black, *profemora* pale yellow lined with black above; underside of *metatibiae* ridged with pale grey; *notum* black, *scuta* and *scutella* yellow. Abdomen very long and slender, 1-2 enlarged, 3 very narrow, widening to 7, 8-9 again pinched. Colour deep shining black, marked with light lemon-yellow as follows—1, a dorsal spot, also yellow on sides; 2, two slanting basal marks nearly touching, *auricles* yellow, genital aperture largely surrounded with yellow; 3-5, a pair of subtriangular basal spots almost touching, a pair of suboval central spots, somewhat pointed basally, separated dorsally by a fine black line; these spots are smallest and closest to base in 5; 6 with basal spots small, central spots flat and distant only one-third from base; 7 nearly all bright yellow, caused by the fusion of two

enormous central spots; basal spots sometimes present, often obsolete, apical seventh of segment black; 8, a tiny basal dorsal spot sometimes present, a pair of subtriangular spots; 9 black; 10 black, a sharp conical upright dorsal spine, black. Appendages: *superior* 3.5 mm., black, fairly straight, tips enlarged both outwards and inwards to a point, forming a barb-shaped end; *inferior* 2.2 mm., narrow subtriangular, slightly upcurved (Plate vii., figs. 3a and b.)

Q. Similar to male, but with shorter body and larger spread of wing. Total length 52-59 mm.; abdomen 40-44 mm.; hindwing 36 mm.; pterostigma 2.4 mm., black.

*Head and thorax* as in male. *Abdomen* thicker, more cylindrical, marked as follows—1, black; 2, black with a pair of irregular slanting yellow spots enclosing a cup-shaped black dorsal area; 3, basal half yellow, enclosing an elongated black diamond-shaped patch, apical half black; 4-6 similar to male; 7, bright yellow all over except last 1 mm. apically; 8 black, a pair of minute yellow spots; 9-10 black, no spine on 10. *Ovipositor* nearly obsolete; reduced to a pair of separate short black processes (see Plate vii., figs. 16a and b). *Appendages* 2.4 mm., black, narrow sub lanceolate, pointed.

*Types*: British Museum and Coll. MacLachlan.

*Hab.*—Queensland, from the Tropic southwards, New South Wales, Eastern Victoria. Inhabits swamps and slow-running creeks in wooded country.

I have taken this beautiful insect at Gladstone(Q.), in the Sydney district(N.S.W.), and at Alexandra(Vic.). Specimens from the last locality are of great size (one being figured in the plate). There is very little variation in the markings of this, the most beautiful member of the genus.

#### *Life-history of Synthemis regina.*

In the Sydney district, this fine insect is found in fair numbers on the slow-running and often stagnant Duck Creek at Auburn. It emerges early in December, and is continually on the wing until the end of March. I have found newly emerged specimens

as late as February. As with *S. eustalacta*, so with this species, females are rarely met with. I have never seen a pair in cop. Females when ovipositing are very shy. They select the deep shady pools, especially on the tributary creeks, overhung with a dense growth of tea-tree. By creeping cautiously along, on a very hot sunny day, and peering down into these pools, I have several times seen the female ovipositing, but have never been able to capture her. She flies rapidly about, close to the water, brushing the tip of her abdomen against the surface of the pool, and apparently laying a very large number of ova over a very small area. I have never seen her molested by males; indeed the spot chosen is generally too shady and retired for any to be found there.

The larva lives in deep mud in the pools, and is a most unsightly object when dredged out of its lair. If carefully cleaned, it exhibits on the abdomen a slight colour-pattern, shewing a pale dorsal band and pale sutures. The following description is taken from a specimen which I took in the act of emerging :—

Total length 22 mm.; abdomen 13 mm.; width of head 5 mm.; wing-cases 6 mm. long; antennæ 2 mm. Colour dark brown; *only slightly hairy*. Head similar in form to that of the larva of *S. eustalacta*(q.v.), but smaller in comparison. Labium of exactly similar pattern, slightly smaller; *mentum* with median lobe advanced to a blunt rounded apex, *mental setæ* 8 primary and 5 secondary; *lateral lobes* with 7 stiff *lateral setæ*; *terminal hook* just above the top seta, very sharp; *distal border* with 7 distinct teeth, similar in form to those of *S. eustalacta* but slightly deeper(Plate ix., fig.2). *Thorax*: *prothorax* broader than head; *meso-* and *metathorax* 6.5 mm. wide, rather flat. *Legs* short, with stout femora, slightly hairy. *Abdomen* considerably broader and flatter than that of *S. eustalacta*, ridges of segments less raised and hairs very short, so that the body is comparatively smooth; underside fairly flat; greatest breadth 7.5 mm. at fifth and sixth segments. *Appendages*: superior 1.3 mm., straight; two inferior 1.5 mm., straight; two lateral 1 mm., straight; all conical.

This nymph can be at once distinguished from any of the other four known species by its greater breadth and flatness, and by the comparative shortness of the anal appendages.

**Types:** Coll. Tillyard (Duck Creek, Auburn, N.S.W.).

#### 4. *SYNTHESIS MIRANDA* Selys.

Selys, *loc. cit.* 1871; Martin, "Cordulines," 1906, p.82, figure of wings; Plate iii., fig.19, coloured figure of type-female.

**♀.** Unique. Half of abdomen lacking. Hindwing 44 mm.

As this species is so carefully figured by Martin, I have omitted it from the coloured Plate. From the very detailed description of de Selys, I append the following points for purposes of comparison:—

Wings very much tinged with russet-brown on their basal halves, especially the hindwing (N.B.—This is a condition often found in newly emerged females); *pterostigma* 3.5 mm., blackish; membranule very long, smoky; all *triangles* crossed; 4-5 cross-veins in basilar space, 8-9 in submedian. Head steely-black, with yellow markings on clypeus and labrum. Thorax brown above; two yellow bands on each side. Legs brownish-black. Abdomen slender, steely-black; 2 with a transverse ray, broken dorsally; 3-4 with small basal spots, 3-5 with a pair of round central spots.

**Hab.**—Supposed to be New Caledonia.

The remarkable discovery of this specimen by de Selys has been already related. It is apparently similar, both in colouration and wing-venation, to the female of *S. regina*, which is also a large insect. In both the anal loop is divided into three portions; a condition existing in no other member of the genus. But the reticulation of *S. regina* is much less dense than in *S. miranda*. In its suffusion with brown, and in the numerous cross-veins, *S. miranda* recalls a large immature female of *S. macrostigma*. It differs, however, from the latter in having the lateral band of the thorax entire.

I do not think that the presence of cross-veins in the triangles, and the generally dense venation warrants the formation of

another genus to receive this species. As I have already shewn, cross-veins often occur as "freaks" in one or more triangles of all members of the group, and are especially likely to occur in the more densely reticulated females. From analogy with *S. regina*, we might expect the male of *S. miranda*, if it is ever discovered, to have only two divisions in the anal loop, and to possess a much simpler reticulation.

#### 5. *SYNTHEMIS LEACHII* Selys. (Plate iv., fig. 4.)

Selys, *loc. cit.* 1871 and 1874; *Synthemis martini* Tillyard, Proc. Linn. Soc. N.S. Wales, 1907, p. 726.

The identity of the species described by me under the name "*S. martini*" with *S. leachii* Selys, has been established beyond doubt through the kindness of Dr. Laidlaw, who compared co-types of my series, sent by me to him, with the original type of de Selys. This identity could scarcely have been guessed otherwise, as de Selys' type is an immature and damaged specimen of so pale a colour that it was more like a specimen of *S. macrostigma*, at first sight. Apparently, too, the distinguishing mark of this species, viz., the four antehumeral thoracic spots, were almost obliterated.

The following description is an abridgment of my original one, and contains all the points necessary for a clear understanding of the differences between this and the other species:—

♂. Total length 55-57, abdomen 42-44, hindwing 32-33 mm.

Wings: *pterostigma* nearly 3 mm., black; *membranule* nearly 3 mm., pale greyish.

Head: *eyes* bright greenish in living insect, brown behind with a creamy mark; *vertex* dark brown; *front* hairy, widely cleft medially, dark brown with a creamy spot on each side; sides of face greyish; *clypeus* greyish tinged with brown, *labrum* and *labium* pale dirty flesh-colour. Thorax: *prothorax* dark brown with a pale mark in front. *Meso-* and *metathorax* dark brownish with a metallic tinge; a straw-coloured line on dorsal ridge; four fair-sized creamy antehumeral spots, the two front ones often cleft, the other two usually round. Sides of thorax with a broad



lateral creamy band, lower part of sides dull greyish; *notum* brown with creamy scutella; *legs* black. Four distinct creamy spots at wing-bases. A b d o m e n pinched somewhat at 3, also at 8-10. Colour: 1, brown with a creamy dorsal spot; 2 brown, a pair of slanting basal marks, and top of auricles, creamy; 3-10 black, spotted with cream as follows:—3-8, a pair of triangular basal spots, and a pair of central roundish spots, the former diminishing from 3 to 8, being only lines in 8, the latter rather pointed basally in 3, round in 4 to 7, smaller and pointed apically in 8; 9 black, often with two tiny spots; 10, with a large central oval or diamond-shaped spot, two tiny lateral spots. A p p e n d a g e s : *superior* 3·8 mm., somewhat forcipate at tips, black; *inferior* 2·2 mm., narrow subtriangular, slightly upcurved, pale brownish with darker tip. (See Plate vii., figs. 5a and b.)

♀. Similar to male but somewhat larger; hindwing 35 mm. *Wings* shaded with brown at bases; *pterostigma* 4 mm., pale. *Head* and *thorax* as in male but somewhat duller in colour, thoracic spots generally larger and more irregular; *abdomen* cylindrical, broader than in male, with larger spots; 9-10 short and narrow; *ovipositor* reaching nearly to end of 10, with a blunt upcurved tip; *appendages* 0·8 mm., short, straight, black. (See Plate vii., fig. 18).

T y p e s : ♂. British Museum("New Holland"); ♀. Coll. Tillyard(Bridgetown, S.W.Australia).

*Hab.*—South-Western Australia, from Perth to Cape Leeuwin.

It occurs fairly commonly on all running streams and mountain brooks, very occasionally also on freshwater lagoons.

Like all *Synthemids*, it has an easy flight and is not difficult to capture. In spite of its dull colouration, it is a most beautiful insect when flying; the eyes gleam like living emeralds. Its nearest ally is *S. macrostigma*, from which it is easily distinguished by its slightly greater size, darker colouration, the four thoracic spots, and the larger inferior appendage of the male.

#### 6. *SYNTHEMIS MACROSTIGMA* Selys. (Plate iv., fig. 5.)

Selys, *loc. cit.* 1871 and 1874.

De Selys described, in 1871, the type-male from a specimen labelled "Oceania" without any further indication of locality, and the type-female from Fiji. In 1874, he added some remarks on specimens in the British Museum, one labelled "North Australia," another (♀) "Swan River," and the rest without any named locality. These he found different in some respects from the Oceanic types.

I have taken a long series on the Blue Mountains, N.S.W., and another series at Bridgetown, W.A. These two series show considerable differences one from another, and also differ in important respects from the types.

I append the following description from the Blue Mountain series, (of which one male is figured in the plate):—

♂. Total length 56 mm., abdomen 42 mm., hindwing 32mm.

Wings: *costa* pale brownish, a pale point on the nodus; *pterostigma* 3.5 mm., deep rose-colour; *membranule* 2mm., pale greyish. In all four wings a touch of dark brown at base of subcostal space. Head: *eyes* reddish-brown, a yellow mark behind; vertex dark brown; *front* dark shining brown in median cleft, pale creamy on sides, so that a rather thick indistinct T-mark is formed; sides of face pale; *clypeus* brown, a pale triangular spot in middle of anteclypeus, *labrum* pale brown, or orange, sometimes with two black points, *labium* pale violet-brown, *mouth* edged with dark brown. Thorax: *prothorax* dark brown, a pale straw-coloured collar in front, a small spot behind. *Meso-* and *metathorax* deep rich chocolate-brown above, with straw-coloured line on dorsal ridge; the dark brown bordered by pale rosy-pink, which curves inwards to the dorsal ridge just above the interalar ridge, forming a beautiful design; sides of thorax rich rosy-brown; lateral stripe broken into two creamy spots, one small and round; the other, enclosing the mesospiracle, narrow elongate; these spots are encircled by a broad lateral band of dark brown which fills the space between them; low down on each side, an elongate creamy mark; *notum* rich brownish, *scutella* creamy; *legs* cinnamon-brown, *profemora* rosy-pink. Abdomen slender, pinched at 3 and again at 9. Colour rich

rosy-brown, with black sutures; marked with creamy spots as follows:—1, pale on dorsum; 2, a pair of triangular spots, auricles brown below, paler above, genital aperture edged with cream; 3, a pair of basal triangular spots, a pair of central spots somewhat elongated basally; 4-7, a pair of small basal spots, a pair of oval central spots; 8, with central spots only; 9, brownish; 10 brown, pale on dorsum. Appendages: *superior* 3.3 mm., wavy, approaching in a slight curve at tips, which are *very slightly* enlarged; a tiny spine underneath near bases; colour dark brown; *inferior* 1.5 mm., narrow subtriangular, pale brownish, tips slightly upcurved (Plate vii., figs. 4a and b).

♀. Very similar to male but somewhat larger, with greater expanse of wing, duller colouration, thicker and more cylindrical abdomen; *pterostigma* 4 mm., pale yellow in teneral specimens, rich brown in mature ones. *Wings* hyaline, even in newly emerged specimens, with basal dark brown touch as in male. *Ovipositor* conspicuous, reaching to middle of segment 10, tip rather blunt, usually scarcely upcurved; very dark brown or black. *Appendages* short, 0.8 mm., subconical, pointed, dark brown (Plate vii., fig. 17).

There is no doubt that this widely distributed species varies considerably in many respects in different portions of its range. I consider that the eastern and western Australian races are sufficiently distinct from one another, and from the oceanic types, to warrant subspecific names. They can be distinguished as follows:—

*A. S. macrostigma macrostigma* Selys.—Hindwing: ♂ 33, ♀ 32 mm. Black mark at base of wings very small in male, lying in submedian space; very large in female, reaching to arculus of forewings and close up to triangle of hindwings, also in submedian space. *Wings* of female *suffused with yellowish*. Front with a *conspicuous* dark T-mark, face and labrum pale. *Appendages* of male brown; 9-10 brown. *Ovipositor* of female, as described by de Selys, very remarkable, reaching nearly to end of appendages, with lamina slightly separated for part of their length, confined again at tips. Types: ♂. Coll. Selys ("Oceania");

♀. Coll. Hagen(Fiji). *Hab.*—Fiji Islands, and probably other Pacific islands lying off the coast of Australia.

*B. S. macrostigma orientalis*, n.subsp.—Described above. It differs from A in the following points—Black mark at base of wings *very small in both sexes, lying in subcostal space*. Wings of female *hyaline, without any suffusion*, even in newly emerged specimens. (I have bred out several females, all with hyaline wings). Front with a very inconspicuous T-mark; face and labrum darker. Appendages of male dark brown, but dorsum of segment 10 partly pale. Ovipositor of female never reaching to end of 10, generally scarcely upcurved at tip. Type-series: ♂♀. Coll. Tillyard(Blue Mountains, N.S.W.). *Hab.*—New South Wales, Victoria, South Australia, and Tasmania. Found on mountain-swamps; distribution local.

*C. S. macrostigma occidentalis*, n.subsp.—Remarkable for the small size of the male, hindwing only 28 mm.; female as large as in A and B. Wings of male hyaline, with a *conspicuous dark brown basal spot* reaching out 2.25 mm. along subcostal space. Female with wings *suffused with yellowish-brown*, costa pale yellow, dark basal marks reaching 3.5 mm. in fore- and 6 mm. in hindwing, along subcostal space. Front with a fairly conspicuous brown T-mark, but face and labrum very pale. *Dorsum of 9-10 and basal three-fourths of appendages of male* very pale. Ovipositor of female reaching just to end of 10, usually with a blunt upcurved tip, similar to that of *S. leachii* in Plate vii., fig 18. Type-series: Coll. Tillyard (Bridgetown, Western Australia). *Hab.*—South-western Australia; very rare. Occurs on swampy creeks. The variability of the ovipositor of this species is a strong argument against the use of that organ for generic distinctions in the group, and serves to support my belief that the ovipositor, where still remaining, is essentially a variable organ in process of reduction from having lost its original use as a terebra.

Life-history of *S. macrostigma orientalis*, n.subsp.

The perfect insect emerges in November, and continues on the wing until February. Immediately the wings are strong enough,

the insect flies off into the bush, where it may remain for weeks. In some localities where I have taken the full-grown nymph very commonly, I have never yet taken the perfect insect, except just emerging. On very bright sunny days the males fly up and down over the reed-beds and swamps, always keeping low and close to the water. They are very easily captured. Females are very seldom seen. The method of pairing is similar to that of *S. eustalacta*. I have once or twice secured a pair, in cop., as far as a mile from the breeding-place, in the bush. The female returns alone to the swamp, and selects a part of it away from the main drainage, where the muddy ooze is only just covered with stagnant water. There she lays her eggs, sometimes hovering in the manner of *S. eustalacta*, and sometimes holding lightly to a reed-stem, still keeping her wings in motion, and washing the eggs out on to the mud at its base. On capturing a female during oviposition, I have never found large masses of eggs, but at the most three or four at a time are exuded, and often none at all. So that it seems that this species is less advanced than any other known to me, in its method of oviposition. The fact that the female still clings occasionally to reed-stems, shews that it has not quite lost the instinct of ovipositing in the *Æschnid* manner. It would be interesting, if the females were commoner, to see if they ever attempt to use their ovipositor as a borer. I have not observed one to do so, but I have seen only half a-dozen females ovipositing altogether.

The young larva, which is very similar to that of *S. eustalacta*, can always be distinguished at once by its labium, and by the fact that it inhabits quite a different part of the swamp. While the nymphs of *S. eustalacta* are always concealed in the mud and silt which accumulates close to the main stream or drainage of the swamp, and are always covered with fairly deep water, those of *S. macrostigma* are found only on the outskirts of the swamp, in vile muddy places where scarcely any water remains, and where the mud is very thick and often caked. By scooping out a small "pot-hole" of mud of this kind, only a few inches across, with my hand, I have often secured several fully-grown larvae.

The only other inhabitants of these places are the small larvæ of species of *Nannodythemis*, and it may be supposed that a large number of these fall victims to the large, ugly *S. macrostigma* nymphs.

The full-grown nymph, an ugly, cumbersome, mud-bedraggled object, crawls out of its "pot-hole," and often travels some yards before ascending a reed-stem to emerge. In the aquarium, these nymphs are very restless and unhappy. Last year, when I had them in an ordinary aquarium with a foot of water, I succeeded in breeding out only one, though many climbed over the edge and wandered away into a corner of the room to die. This year, I placed them in a flat round tin, a yard in diameter, and just covered the sand with water. Here they have done exceedingly well, and all so far have emerged by ascending the reed-stems placed against the edges. They have, however, the greatest difficulty in climbing, and assume all kinds of absurd attitudes in their efforts to secure a firm hold before emerging.

Ovum slightly larger than that of *S. eustalacta*, pale straw-coloured, semitransparent. Nymph (full-grown) almost exactly like that of *S. eustalacta* in shape, but larger, with a large abdomen, and very dark in colour, some specimens when cleaned being almost black, with paler hairs. Total length 24, abdomen 14, breadth of head 6, wing-cases 7 mm. Head dark brown, with frontal tuft of hairs long and matted, postocular lobes hairy. Labium very distinct from that of any other known species. (Plate ix., fig. 3). Considerably larger than that of *S. eustalacta*. *Mentum* with the median lobe projecting forward into a distinctly protruding point. *Mental setæ*: 5 primary, 6 secondary. *Lateral lobes* with 5 stiff *setæ* and a strong sharp terminal hook; distal border very strongly *dentate*, with four or five large teeth, the lower one rounded (that on the right notched so as to fold over the protruding median lobe), the others rather sharp and triangular; largest tooth 0.7 mm., wide by 0.4 mm. high. *Thorax* broad, rather hairy; legs fairly long, stout, brownish, very hairy. Measurements of hind-leg, 7 + 5.5 + 3.5 mm. *Abdomen* long, elongate-oval, very dark brown or black, with long fine hairs

which often gather in tufts when wet. *Appendages*: superior 1.8 mm., tip curved downwards; two inferior 2.1 mm., straight; two lateral 0.8 mm., straight. In the dentition of its labium, this species shews the closest approximation to *Cordulegaster*. It is probably as deeply dentate as that of any known *Corduline* nymph, except *Cordulephya*. Types: Coll. Tillyard (Leura, Blue Mountains).

#### 7. *SYNTHEMIS PRIMIGENIA* Förster.

Förster, Odonaten aus Neu-Guinea, 1903.

The following abridgment of Förster's description (in German) will be sufficient to give the points of detail in which this species differs from the others:—

♂. Abdomen 45-48 mm., hindwing 34-36 mm.

*Wings*: *costa* pale yellow in front; *pterostigma* 2 mm., black; *membranule* 2.5 mm., greyish. One row of post-trigonal cells, one cross-vein in basilar space. *Head*: *vertex* metallic blue; *front* cleft medially, metallic blue, lower third yellow; *face* and *labium* brilliant brownish-black, base of anteclypeus pale yellowish-green. *Thorax*: *prothorax* black, yellow on front and hind borders. *Meso-* and *metathorax* brilliant metallic-blue, a yellow line on dorsal ridge; sides with a broad yellow band enclosing the meso-spiracle; underside yellowish. *Legs* short, black. *Abdomen* very slender, pinched at 3, broadening to 8, 9-10 narrower. Colour jet black; 2-4, two round yellow dots in middle, traces of same on 5-6; 8 with a longer yellow spot finely divided dorsally, 7 and 9-10 quite black. *Appendages*: *superior* 3 mm., black, somewhat forcipate towards tips; *inferior* scarcely two-thirds as long as superior, narrow subtriangular (see Plate vii., figs. 7a and b).

♀. Abdomen 47, hindwing 41 mm. *Abdomen* stouter and more cylindrical than in male, black, with yellow dashes or dots as follows—middle of 2, each side of base of 3, two fine dots on middle of 4-6; underside reddish-brown. *Ovipositor* very long and sharp, extending well beyond the end of segment 10.

*Types*: ♂. National Museum of Hungary; ♂♀. Coll. Förster (Huon Gulf, Simbang, and Tamai Island, New Guinea).

*Hab.*—New Guinea; taken by Karl Wahnes, in March, 1900.

This species, the only known representative of the genus in New Guinea, is quite distinct from all the others, especially because of its very long ovipositor, which seems to be still capable of being used as a borer, judging by its shape. In this character, it is certainly the most archaic member of the group. The species is figured well in Martin's "Cordulines," Plate iii, fig. 20, and the male appendages on p 84 (fig. 98).

8. *SYNTHESIS CLAVICULATA* Tillyard. (Plate iv., fig. 6).

Tillyard, Proc. Linn. Soc. N. S. Wales, 1908, p. 749 (♂ only).

A second male of this rare species, and a female, the latter rather immature, have just been forwarded to me by my friend, Mr. E. Allen, of Cairns. They were taken in the same locality, near Kuranda, as the type-male. As this second male is in very good condition, I have figured it in the plate, and append a brief description.

♂. Total length 49, abdomen 38, hindwing 32 mm.

Wings: *costa* pale yellowish outwards; bases slightly saffroned; *ptero stigma* 1.8 mm., black; *membranule* 2.5 mm., greyish. Head deep black, except two large yellow spots on front, two dull yellow spots on labrum. Thorax brilliant deep metallic bluish-green, dorsal ridge and two large antehumeral bands bright yellow; sides with a broad lateral yellow band extending completely across notum; below this a narrow band of metallic greenish-blue, rest of sides and underside yellow. Abdomen blackish marked with bright yellow as follows—1, a triangular dorsal spot; 2, basal two-thirds, auricles, and genital apertures all yellow; 3-6 with a pair of conspicuous central spots, oval in 3-4, decreasing in size to 6, where they are round; 7, with a pair of larger spots close to base; 8, with two very large spots, covering three-fourths of segment; 9, two small basal spots; 10 black, apical edge slightly raised dorsally. Appendages: *superior* 3 mm., black, wavy, slightly clubbed at tips, hairy; *inferior* 1.3 mm., black, tip upcurved (see Plate vii., figs. 6a and b).



♀.(Unique): abdomen 33, hindwing 34 mm. Wings: bases of forewings beautifully saffroned for 5 mm., those of hindwings for 3.4 mm. *Pterostigma* 2 mm., black. Head almost completely shiny black, yellow frontal spots much smaller than in male. Thorax deep metallic steely-blue, marked as in male. Abdomen (flat and ill-nourished) broader and more cylindrical than in male, marked with smaller and paler spots. *Ovipositor* almost obsolete, reduced to a tiny black projection, similar to that figured for *S. cyanitincta*. *Appendages* 1.2 mm., black, cylindrical.

Type: Coll. Tillyard, ♂♀ (Kuranda, N. Queensland; E. Allen).

*Hab.*—Apparently confined to one locality near Kuranda. Very rare; January.

#### 9. SYNTHEMIS CYANITINCTA Tillyard. (Plate v., fig.7).

Tillyard, Proc. Linn. Soc. N. S. Wales, 1907, p.724.

The following is an abridged description, for comparison with other species:—

♂. Total length 41 mm., abdomen 31 mm., hindwing 26 mm.

Wings slightly suffused with brownish, bases slightly saffroned, a black mark for 2 mm. along subcostal space; *pterostigma* 2 mm., brown; *membranule* 3 mm., dull whitish. Head: *eyes* green in living insect, bordered behind with white; *vertex* dark brown; *front* deeply cleft, brown, with creamy spots on sides; *clypeus* and *labrum* brownish; *labium* dull brown. Thorax dark chocolate-brown, a pair of short straight antehumeral stripes, of a pale bluish or creamy colour; sides with a broader lateral stripe enclosing the mesospiracle, and a large patch, low down, of the same colour; *notum* brown with creamy scutella; *legs* black, bases of femora brown. Abdomen slender, rather short, not very pinched at 3, 7-10 somewhat enlarged. Colour dark brown shading to black, marked with pale bluish spots as follows—2, a pair of semicircular spots; auricles creamy; 3-7, a pair of central dorsal spots, oval or sub-oval; 8, a pair of large oval spots; 9, a pair of small round basal spots; 10 variable, marked with cream or pale bluish; 8, underneath carries a conspicuous bunch of hairs. *Appendages*:

*superior* 3 mm, slightly wavy, black, pointed; *inferior* 1.8 mm., brown, narrow subtriangular, tip upcurved (see Plate vii., figs. 8a and b).

♀. Slightly different from male. *Wings* often much suffused with brown; *pterosigma* pale brown; *anteclypeus* with small triangular creamy spot. *Abdomen* thicker than in male, cylindrical, rather short, 2-7 spotted as in male, 8 with smaller spots, 9-10 brown; colour of spots and thoracic stripes usually dull creamy. *Ovipositor* almost obsolete, being represented by a very small projection under apex of 8; *appendages* 1 mm., black, straight, pointed (see Plate vii., figs. 21a and b).

Type-series: Coll. Tillyard, ♂♀ (Margaret River, W.A.).

*Hab.*—Scattered localities in South-Western Australia. Margaret River, Armadale, Waroona (a series from the latter locality taken by Mr. G. F. Berthoud). Inhabits small running brooks. December and January.

Easily distinguished from all others of the genus by its small size, pale bluish markings, and the tuft of hairs under segment 8 of male. Allied to *S. claviculata* in the reduction of its ovipositor, and in possessing antehumeral thoracic stripes, but not in other respects.

## Genus 2. METATHEMIS, n.g.

Membranule present; front large; abdomen (except in *M. nigra*) not much pinched at 3, broadened at 8-10. Superior appendages of male short, more or less forcipate, inferior nearly as long. Females with tip of abdomen rounded, *no ovipositor*, 9-10 not reduced in depth, but short. Larvæ with a conspicuous frontal plate, flat and semicircular, projecting in front between the eyes; build rather stout. Type: *Synthemis guttata* Selys.

### Key to Species of *Metathemis* (both sexes.)

- |      |  |                        |
|------|--|------------------------|
| 1. { | A pair of antehumeral thoracic stripes, yellow. ....     | <i>M. virgula</i> .    |
|      | { No antehumeral thoracic stripes ... ..                 | 2.                     |
| 2. { | Four distinct white or yellow spots at wing-bases ... .. | 3.                     |
|      | { No spots on wing-bases. ....                           | <i>M. guttata</i> .    |
| 3. { | Lateral thoracic stripe entire. ....                     | <i>M. nigra</i> .      |
|      | { Lateral thoracic stripe cut in two, irregular. ....    | <i>M. brevistyla</i> . |

1. *METATHEMIS GUTTATA* Selys (Plate v., fig.8)

*Synthemis guttata* Selys, *loc. cit.*, 1871 and 1874.

A full description of this insect, which is needed to supplement de Selys' descriptions of fragmentary specimens, is here given:—

♂. Total length 45.50; abdomen 33.37; hindwing 29.32 mm.

Wings: *neuration* black, open; *pterostigma* 2.5-2.8 mm., black; *membranule* 2 mm., grey-brown, no spots at wing-bases. Head: *eyes* green in living insect; *vertex* black; *front* jet black, with two large straw-coloured or creamy spots separated by a very wide black band in median cleft; *postclypeus* black with a small spot at each side; *anteclypeus* creamy, or black with two creamy spots, *labrum* and *labium* black, mouth touched below with brown. Thorax: *prothorax* black; *meso-* and *metathorax*: very dark brown with dense hairs, dorsal ridge creamy, bordered on each side by a broad black band, indistinct; on each side a broad straight lateral band, *entire*, and a large patch low down, both creamy or pale straw; *notum* black, crossed by the lateral creamy band; *scutella* creamy; *legs* black, underside of profemora partly pale brown. Abdomen enlarged at 1.2 and 8-10 considerably. Colour black, marked with cream or pale straw as follows:—1, sometimes a triangular spot; 2, two small flat spots, auricles creamy above; 3, two small basal spots, wide apart, two central spots, oval, close together; 4-7, a pair of dorsal central oval spots, very small on 6; 8 with a pair of larger central spots, often pointed apically; 9-10 black. Appendages: *superior* 1.5 mm, black, forcipate, with a small spine on outer border one-third from base; slightly hairy; *inferior* nearly as long, broad, subtruncate, slightly upcurved. (See Plate vii., figs. 11a and b).

♀. Considerably larger than male, *abdomen* 34, *hindwing* 36.38 mm. *Wings* sometimes suffused with blackish at bases, especially along subcostal space; *pterostigma* 2.8-3 mm., black. *Head* blacker than in male, with smaller spots. *Thorax* and *abdomen* very dark, almost black; thoracic stripes broad and regular; *abdomen* broader than in male, cylindrical, 9-10 slightly enlarged,

marked with creamy spots as follows:—1, a dorsal mark; 2, a sub-basal transverse band, broken on dorsum; 3, two small basal spots wide apart; 3-7, a pair of small rounded central spots; 8, a pair of *smaller* basal spots; 9-10 black. No ovipositor, central folds of 8-9 wide open as in *M. virgula* (Plate vii., fig. 23). *Appendages* 0.7 mm., black, straight, pointed, separated, a round hairy tubercle projecting below on 10.

*Types*: Coll. Selys, ♂♀ ("New Holland").

*Hab.*—Southern Queensland, New South Wales, Victoria. Common on fast mountain-streams.

*Var.*—Specimens from the Illawarra District of New South Wales are of small size, and the male has a pale creamy or straw-coloured labium. I propose to name this var. *pallida*; it does not deserve subspecific rank.

#### Life-History of *Metathemis guttata*.

The perfect insect emerges in November, and continues a long time on the wing, specimens being occasionally taken as late as May. It is not common in the Sydney district, but I have studied its habits on the Blue Mountain creeks, where it is often abundant. Females are excessively rare compared with males; for instance, I have seen only one pair this year, though I have captured many males. Pairs are usually seen in the bush, away from water. The female returns to the creek alone, and oviposits in a rapid, rather frightened manner, flying quickly up and down the creek, and dipping the tip of her abdomen continually into the water. The eggs are exuded in large masses, and are similar to those of *S. eustalacta* in size and shape, but greyish or dull brownish in colour, semi-transparent.

The larva lives in the clean sand of the clear running mountain-streams. In concealment, it throws up sand over its back, and settles down into a slight hollow, its eyes, frontal ridge and edge of labium, and anal appendages alone being visible. In this position in my aquarium, I have frequently fed it with mosquito-larvæ, which it eats with great avidity. When full-fed, it crawls to the overhanging bank of the stream, and clambers up the

twigs or stalks of fern and grass that fringe it. It does not experience quite as much difficulty in climbing as do the larvæ of *S. eustalacta* and *S. macrostigma*; this is perhaps due to its being free from slippery mud. One or two have climbed straight up out of a deep aquarium and emerged.

In appearance and shape, there is great similarity between the nymphs of *S. eustalacta* and *M. guttata*. There are, however, the following important differences—the abdomen of *M. guttata* is slightly longer, and the hindlegs shorter than in *S. eustalacta*. There is a conspicuous flat semicircular plate projecting in front, between the eyes, in *M. guttata* (see Plate viii., fig. 5). The whole insect is comparatively clean, (from its habit of living) and the abdomen shews a distinct colour-pattern of light and dark brown; each segment carrying a dorsal stripe and a large irregular spot on each side, of a pale colour. The body is less hairy than in *S. eustalacta*, the hairs of the segmental ridges being few and very fine, generally 4-5 on each side and none on dorsum.

**Labium:** *mentum* slightly more triangular than in *S. eustalacta*; the median lobe with a distinctly protruding central angle, as in *S. macrostigma*; *mental setæ*, 5 primary, and 7-8 secondary; *lateral lobes* with six stiff *lateral setæ*, and a sharp *terminal hook*; distal margin with 6-7 rather flat rounded teeth, the largest being 0.2 mm. wide by 0.1 mm high (Plate ix., fig. 4). **Anal appendages:** *superior* 1.3 mm., *distinctly curved downwards at tip*; two *inferior* 1.4 mm., also curved downwards slightly; two *lateral* 0.8 mm., straight.

**Types:** Coll. Tillyard (Leura, Blue Mountains).

## 2. *METATHEMIS NIGRA* Tillyard. (Plate v., fig. 9).

Tillyard, Proc. Linn. Soc. N. S. Wales, 1906, p. 489.

Since publishing the description of this species, I have received from Mr. F. P. Dodd, of Kuranda, a pair of this species which differ in some respects from the type. These more than ever convince me of the absolute distinctness of this species from *M. guttata*. The following short description is appended for comparison:—

♂. Total length 50, abdomen 38, hindwing 33 mm.

**Wings:** *neuration* black, very open, costa yellowish outwards; *pterostigma* 2.5 mm., black; *membranule* 1.5 mm., dark brown. **Head:** *eyes* green in the living insect; *vertex* black; *front* dark metallic blue, with two round creamy or pale yellow spots, *close together, placed well in front*, and bordered on sides by a greyish-brown patch; *clypeus* black, with two small central pale spots on anteclypeus; *labrum* black; *labium* brownish. **Thorax** black with metallic greenish-blue reflections, dorsal ridge creamy or greyish; on each side a broad continuous creamy lateral band, and low down a small spot and larger subtriangular area of same colour. *Four distinct spots at wing-bases.* **Notum** black, crossed by the lateral band, scutella creamy; *legs* black, part of profemora brownish. **Abdomen** *very slender*, much pinched at 3, then broadening to 6, 7-10 narrower (8 somewhat pinched in the specimen figured). Colour metallic black with creamy spots as follows—2, a pair of slanting points; auricles dark; 3-4, a pair of basal dots and a pair of central dots; 5-7, a pair of central dots only; 8, two tiny points one-third from base; 9-10 black. (These dots were either obliterated in the type-specimen, which was in poor condition, or else not present). **Appendages:** *superior* 1.5 mm., slightly forcipate, hairy, a small spine on outer margin close to bases, black; *inferior* nearly as long, broadly truncate (see Plate vii., figs. 12a and b).

♀ A larger and stouter insect, with shorter and more cylindrical abdomen; hindwing 36 mm. *Wings* suffused all over with russet-brown. *Markings* of head and thorax as in male but yellow; spots of 6-8 generally obsolete; all spots pale yellow; 10 projecting below in a rounded hairy tubercle. *Underside* of 8-10 similar to that of *M. virgula* (Plate vii., fig. 23); *no ovipositor.* *Appendages* 1 mm., hairy, black, straight.

**Types:** Coll. Tillyard, ♂♀ (Kuranda, N. Queensland).

**Hab.**—Northern Queensland; not uncommon; November to March.

The colouration reminds one of *Synthemis primigenia*. Its nearest ally is rather *M. brevistyla* than *M. guttata*, for it agrees with the former in possessing the four bright spots at wing-bases,

and in having the frontal spots close together; whereas with the latter it agrees only in having the lateral thoracic band entire. However, in its general shape and appearance it is much the most distinct species of the four comprising the genus.

### 3. *METATHEMIS BREVISTYLA* Selys. (Plate v., fig. 10).

*Synthemis brevistyla* Selys, *loc. cit.* 1871.

♂. Total length 43, abdomen 32, hindwing 31 mm.

Wings slightly tinged all over with pale brownish; *neuration* closer than in the two preceding species; pterostigma 3 mm., black; *membranule* 2 mm., greyish. Head: *eyes* deep green in living insect; *vertex* black; *front* black with two large pale yellow spots, separated by a rather narrow black band in median cleft, and extending on to sides, where their colour is more greyish; *clypeus* black, a central yellow mark on anteclypeus; *labrum* black; *labium* pale straw-colour. Thorax very dark brown, dorsal ridge yellow, a deep steely-black band on each side of it; sides steely-black; lateral band completely broken, forming two elongate-oval irregular spots, bright yellow; low down, a small round yellow spot in front, a larger yellow area behind; *notum* dark brown; *scutella* yellow; four distinct bright yellow spots at wing-bases; *legs* black, underside of profemora pale brownish. Abdomen: 1-2 and 7-10 somewhat enlarged, very dark brown shading to black, marked with bright yellow as follows—1, a dull dorsal mark; 2, two slanting spots and auricles; 3, basal half yellow enclosing an elongate-oval black mark with a fine apical stem; 4-6, a pair of small basal spots, a pair of small central spots; these spots largest in 4, decreasing rapidly to 6; 7, with small central spots only; 8, a pair of large spots occupying the basal half or more of the segment; 9, two small triangular basal spots wide apart; 10 black. Appendages: *superior* 1.5 mm., black, somewhat forcipate, a small spine on outer margin near bases; *inferior* not quite as long, broad, nearly black, truncate (Plate vii., figs. 9a and b).

♀. Very similar to male, but somewhat larger; hindwing 32 mm., bases of wings touched with blackish-brown; pterostigma 3.3 mm.,

dark brown. *Head* and *thorax* as in male. *Abdomen* shorter and stouter, more cylindrical; markings similar to male, but all spots larger except those of 8, which are slightly smaller; 9, black; 10, very short, black, ending in a large rounded hairy protuberance below appendages. No ovipositor, underside of 8-10 similar to *M. virgula* (Plate vii., fig. 23). *Appendages* 1 mm., straight, black, pointed, very slender.

*Types*: Coll. Selys, ♂♀ (immature) (Port Denison, Queensland).

*Hab.*—Queensland, New South Wales, Victoria; November to March.

It occurs along the larger rivers, often in company with *M. virgula*, but very seldom in the same localities as *M. guttata*. It is especially abundant in Victoria and Southern New South Wales, where the specimens are larger than the Queensland types. The series described above by me, and of which the male is figured in the plate, were taken at Alexandra, Victoria.

#### 4. *METATHEMIS VIRGULA* Selys. (Plate v., fig. 11).

*Synthemis virgula* Selys, *loc. cit.* 1874.

♂. Total length 49; abdomen 37; hindwing 29 mm.

*Wings*: *costa* bright yellow outwards, venation more open than in *M. brevistyla*; *ptero stigma* 2.6 mm., black; *membranule* 3 mm., pale greyish. *Head*: *eyes* dark green in living insect; *vertex* black; *front* yellow, a narrow black band in the median cleft, face yellow above and on sides, a large brown rectangular patch in middle; *clypeus* and *labrum* yellow edged with brown; *labium* pale yellow, mouth touched with brown. *Thorax* dark brown, with indistinct steely reflections above; dorsal ridge yellow; a pair of bright yellow antehumeral bands, pointed sharply towards interalar ridge; sides brown with steely reflections, a bright yellow lateral band, *irregular but continuous*; a large yellow patch low down. *Notum* brown, scutella yellow; a distinct yellow spot at each wing-base; *legs* black, underside of profemora pale brown. *Abdomen*, 1-2 and 7-10 somewhat swollen, 3 rather narrow. Colour deep brown shading to black, marked with bright yellow as follows:—1, an indistinct dorsal



spot; 2, two large spots and auricles; 3, basal half yellow, enclosing a narrow elongated basal oval mark on dorsum, sometimes with a dark apical stem; 4, sometimes with basal half as in 3, sometimes with a pair of basal triangular spots and a pair of central spots, conjoined; 5-6, a pair of basal spots and a pair of central spots, small; 7, basal spots almost obsolete, central spots round and small; 8, with two very large spots occupying the basal half or more of the segment, and very close together; 9, two large subtriangular basal spots; 10, two smaller roundish spots. Appendages: superior 1.8 mm., black, somewhat forcipate, no spine at bases; inferior nearly as long, broad, truncate, black. (Plate vii., figs. 10a and b).

♀. Very similar to male, hindwing 33 mm.; pterostigma 3 mm., dark brown; wings suffused with pale yellowish-brown. Front with brown mark in cleft slightly wider, otherwise head and thorax as in male. Abdomen slightly shorter and more cylindrical, 1-8 spotted as in male; 9, with smaller spots; 10, very short, black. Underside of 8-10 as figured in Plate vii., fig 23; no ovipositor, folds of 8 pale yellow, of 9 touched with yellow, rest dark brownish-black. Appendages 1 mm., thin, straight, pointed, black; 10 ending beneath in a rounded hairy tubercle with two smaller tubercles, one on each side, beneath it.

Types: Coll. MacLachlan, ♂♀ (Melbourne).

Hab.—Southern New South Wales, Victoria. November to March.

It is usually found in the same localities as *M. brevistyla*, though always in less abundance. The series described above were taken at Alexandra, Victoria.

### Genus 3. *CHORISTHEMIS*, n.g.

Membranule absent or quite insignificant; front small; abdomen slender, cylindrical. Superior appendages of male of medium length, slender, almost straight. Ovipositor of female variable. Larvæ similar to those of *Synthemis*, s.str., but smaller and of slenderer build; front with a small rectangular projecting plate fringed with small hairs. Type: *Synthemis flavoterminalis* Martin.

*Key to Species of Choristhemis.*

- |   |   |                           |
|---|---|---------------------------|
| { | Medium size, metallic-black and bright yellow, no antehumeral thoracic stripes.....       | <i>C. flavoterminata.</i> |
|   | Small size, duller black and creamy, a pair of straight antehumeral thoracic stripes..... | <i>C. olivei.</i>         |

## 1. CHORISTHEMIS FLAVOTERMINATA Martin. (Plate v., fig 12).

*Synthemis flavoterminata* Martin, Mém. Soc. Zool. France, 1901.

♂. Total length 46, abdomen 36, hindwing 31 mm.

Wings hyaline in mature insect, tinted with brownish-yellow in teneral specimens; *pterostigma* 2.5 mm., black. Head: *eyes* bright greenish in living insect; *vertex* black; front slightly cleft, bright yellow; *postclypeus* black, *anteclypeus* yellow; *labrum* jet black; *labium* yellowish-brown. Thorax: *prothorax* black with a large yellow dorsal spot. *Meso-* and *metathorax* metallic steely or greenish-black; dorsal ridge yellow, two round yellow spots near interalar ridge; sides with a broad irregular lateral band, a small round spot low down in front, and a large area on metapleurum, all bright lemon-yellow; *notum* black, with yellow scutella and scuta; *legs* black, basal half of profemora yellow. Abdomen black spotted with lemon-yellow as follows—1, either a dorsal cross, or a dorsal and two lateral spots; 2, a dorsal cross or fleur-de-lys; auricles yellow; genital aperture surrounded with yellow; 3-4, basal half yellow enclosing an elongated dorsal mark; 5-7, a pair of small basal spots, a pair of small central spots, both decreasing in size from 5 to 7; 8, two small basal spots or points; 9-10 very variable, but mostly yellow; sometimes clear, sometimes with black suture or spots, or a black W-mark. Appendages: *superior* 2 mm., black, narrow subcylindrical, tips somewhat blunt, downy; *inferior* two-thirds as long, subtriangular, tip truncate, slightly upcurved, black (Plate vii., figs. 13a and b). Genital aperture of segment 2, viewed in profile, is figured, (Plate vii., fig. 15).

♀. Similar to male; expanse of wing greater; wings usually suffused with pale yellowish-brown. Head and thorax as in male, except front, which is black with a large yellow spot on each side. Abdomen cylindrical, much stouter than in male; marked

as in male, except—2, a yellow dorsal line and a pair of small central spots, 3-7 with bases almost completely yellow; 7 a small dorsal spot; 8, variable, usually black with an anal yellow spot; 9, variable, usually apical two-thirds yellow; 10, black, sometimes with a pair of yellow spots. *Ovipositor* black, variable in length, with segments 8-9 also varying in length and position above it; rather short and broad, tip rounded, and carrying above a small gelatinous patch of varying size. Plate vii., figs. 22a, b and c, shew the variations of the end of the abdomen; fig. 22d is 22a seen from below. *Appendages* 1mm., black, slender, straight; 10 projecting below in a rounded hairy tubercle.

*Var.*—Besides the variation of the colouration of the end abdominal segments already noted, there is, in North Queensland, a well-defined dwarf form: *abdomen* 32, *hindwing* 29; *pterostigma* 2 mm.; *only one row of post-trigonal cells*, whereas typical specimens have one or more sets of two cells, followed by single cells, after the triangle. Specimens from intermediate localities shew intermediate variations.

*Types*: Coll. Martin, ♂♀ (New South Wales).

*Hab.*—New South Wales and Queensland, from Illawarra to Cape York.

The series described above was taken around Sydney.

#### *Life-History of Choristhemis flavoterminalis.*

The perfect insect emerges in November, and continues on the wing until March or April. It is found only along densely wooded creeks and rivers, and prefers swiftly running water. The method of pairing and oviposition is similar to that of *M. guttata*, but the eggs are not exuded in such large quantities, and are pale yellowish in colour. The larva lives in the sand at the bottom of the deeper pools, or under the sides of the stream where the bank overhangs and the water is fairly deep. It emerges by climbing up the stalks of fern and grass, often to a considerable height. The full-fed nymph is very dark brown, usually fairly clean, but less so than that of *M. guttata*. Owing to its greater villosity, particles of sand and silt often adhere to

it after emergence. In general appearance it resembles the nymph of *S. eustalacta*, but is much slenderer and smaller. Total length 17; abdomen 9.5; breadth of head 4; wing-cases 5 mm. Legs fairly long. Abdomen with rows of curved hairs on each segmental ridge. Labium: *mentum* rather short with fairly broad base, median lobe triangular, but with no projecting point; *mental setæ*, 6 primary, 8 secondary. *Lateral lobes* rather small, with six stiff *lateral setæ* and a sharp *terminal hook*; *distal border* carrying six well-formed and rather rounded teeth, very similar in shape to those of *S. eustalacta*, but not quite so high. (Plate ix., fig.5). *Anal appendages of abdomen*: superior 1.2 mm., with tip curved downwards; two inferior 1.4 mm., straight; two lateral 1 mm., straight.

**Types:** Coll. Tillyard (North Sydney).

## 2. CHORISTHEMIS OLIVEI Tillyard. (Plate v., fig.13).

*Synthemis olivei*, Tillyard, Proc. Linn. Soc. N. S. Wales, 1908, p. 747.

The following abridged description will serve to distinguish it:—

♂. Total length 39, abdomen 30, hindwing 27 mm.

**Wings:** *neuration* fine, open; *pterostigma* 1.7 mm., black. **Head:** *eyes* grey-green in living insect; *vertex* black; *front* dull whitish; *clypeus* whitish with black sutures; *labrum* white with a fine transverse black line; *labium* pale brownish. **Thorax:** *prothorax* brown, collar and two dorsal spots white. *Meso-* and *metathorax* deep black; dorsal ridge creamy; two creamy antehumeral rays, straight and narrow, followed by two small white spots; sides black with a large lateral irregular mark like the letter "n" flattened, and another patch low down, both creamy. **Abdomen** very slender, cylindrical, black, marked with straw-colour as follows—2, a pair of dorsal marks; auricles creamy; 3-8, a pair of basal spots, and a pair of smaller central spots, decreasing from 3 to 8; 9-10 black. **Appendages:** *superior* 1.8 mm., slender, straight, pointed, with two stiff hairs at tips,

black; *inferior* 1.3 mm., broader, truncate, black, tip upcurved (Plate vii., figs. 14a and b).

♀. Unknown.

Type: Coll. Tillyard, two males (Cooktown, N. Queensland).

*Hab.*—North Queensland. Very rare. Inhabits small mountain-creeks and bogs. December-January.

#### APPENDIX.

##### *Details of material examined.*

I append lists of (1) set specimens of imagines; and (2) mounted specimens of larvæ and exuviae, in my collection. These have formed the main material studied for the purpose of this paper. Many other specimens, mostly taken by myself, have passed through my hands, and have been distributed as duplicates; when such specimens came from localities not otherwise included, they are noted in brackets. Unless otherwise stated, the specimens were taken by myself. Specimens bred from larvæ, or taken in the act of emergence, are placed pinned beside the exuviae, and are not included in List i.—except two *Synthemis macrostigma* ♀, which bred out, and were set and placed with the series of imagines.

##### List i. (Set specimens of imagines).

*Synthemis eustalacta* Burm.—Blue Mts., N.S.W., (Laura) Feb., 1905, 5 males: (Medlow) Jan., 1910, 1 male—Jindabyne, N.S.W., Jan., 1910, 7 males, 6 females—Alexandra, Vic., Dec, 1906, 1 female. *Total*, 13 males, 7 females. [Other localities, Macedon, Vic. (G. Lyell); Burnside, S.A. (S. Angel)].

*S. tasmanica*, n.sp.—St. Patrick's River, Tas., Jan., 1909; 3 males, 3 females—Launceston, Tas., Jan., 1909, 5 males: Cressy, Tas., Jan., 1909, 2 males, 2 females. *Total*, 10 males, 5 females.

*S. regina* Selys—Sydney, N.S.W., (Duck Creek, Auburn) Dec., 1905, 1 female; Feb., 1906, 1 female; Feb., 1907, 5 males, 1 female; Jan., 1908, 3 males, 1 female; March, 1908, 1 female; April, 1908, 3 females; Dec., 1908, 1 female—Gladstone, Q., Jan., 1908, 1 male—Alexandra, Vic., Dec., 1908, 4 males, 1 female. *Total*, 13 males, 9 females.

I. TABLE OF WING-DIFFERENTIALS

Species.	Cross-veins in		Cells in anal loop.*		Rows of post-trigonal cells in forewing.		Pterostigma length in mm.	
	Radial Space.	Submedian Space.	♂.	♀.	♂.	♀.	♂.	♀.
<i>S. caudibacta</i> .....	3	4-6	6-9	10-14	1 or 2	2	2.5	2.6
<i>S. isomaculata</i> .....	3-4	4-6	6-9	8-14	1 or 2	2	2.5	2.8
<i>S. rufipes</i> .....	3-5	4-6	(3-4) + (6-7)	(2-4) + (5-8) + (8-12)	1 or 2	2	2.4	2.4
<i>S. miranda</i> .....	4-5	3-9	—	(7) + (8) + (17)	—	2	—	3.5
<i>S. leopoldi</i> .....	1	3-8	6-8	8-15	1 or 2	2	3	4
<i>S. macrostigma</i> .....	1	3-4	6-8	(3-5) + (8-12)	2	2	3.5	4
<i>S. prismatica</i> .....	1	♂ 3-4, ♀ 4-7	4	?	1	1	2	3
<i>S. alpiculata</i> .....	1	4.5	6-7	14	1	1	1.8	2
<i>S. cyathibacta</i> .....	1	3-4	4-6	9-12	1	1 or 2	2	3
<i>M. guttata</i> .....	2	4-5	7-10	10-15	1 or 2	2	2.5-2.8	2.6-3
<i>M. nigra</i> .....	2-3	5-8	6-7	11-13	1	2	2.5-2.8	2.5-2.8
<i>M. breviscula</i> .....	2-3	5-6	10-14	12-16	2	2	3	3.3
<i>M. virgula</i> .....	2	4-6	7-9	10-12	1 or 2	2	2.6	3
<i>C. flaviterminata</i> .....	2-3	4-6	6-7	6-7	2 or 1	1	2.5	2.7-3
<i>C. olives</i> .....	2-3	3-4	6	—	1	—	1.7	—

\* Where there is more than one division in anal loop, the number of cells is indicated for each division in brackets, beginning from the basal division.——The frequent presence of occasional veins in triangles and hypotrigonal spaces renders these parts unsuitable for differentiation.——Sectors of arcules well fused in all species except *S. cyanithicta*.——Hind-wing triangle not recessed to level of arculus, except in *S. cyanithicta*.

II. TABLE OF DIFFERENTIALS FOR KNOWN NYMPHS.

Species.	Labium.					Abdominal, Anal Appendages in mm.		
	Median lobe.	Mental setae.		Lateral setae.	Dentition.	1 sup.	2 inf.	2 lat.
		Primary.	Secondary.					
<i>S. caudibacta</i> .....	not projecting	5	4	5	7 medium, round	1-6, curved	1-8, straight	0.7, straight
<i>S. rufipes</i> .....	not projecting	8	5	7	7 medium, round	1-3, straight	1-5, straight	1-0, straight
<i>S. macrostigma</i> .....	projecting	5	6	5	4-5 large, triangular	1-8, curved	2-1, straight	0-8, straight
<i>M. guttata</i> .....	projecting	5	7-8	6	6-7 flat, round	1-3, curved	1-4, curved	0-8, straight
<i>C. flaviterminata</i> .....	not projecting	6	8	6	6 medium, round	1-2, curved	1-4, straight	1-0, straight

*S. leachii* Selys—Armadale, W.A., Dec., 1906, 3 males, 1 female: Bridgetown, W.A., Jan., 1907, 8 males, 3 females: Margaret River, W.A., Jan., 1907, 1 male, 2 females. *Total*, 12 males, 6 females. [Other locality, Mungar's Lake, Perth, W.A.].

*S. macrostigma* Selys, race *orientalis* Tillyard—Blue Mts., N.S.W., (Leura) Feb., 1905, 3 males; Dec., 1908, 2 males: (Medlow), Jan., 1910, 10 males, 7 females; two females bred Dec. 26th, 1909, and Jan. 6th, 1910, from larvæ taken at Leura, Oct., 1909—Macedon, Vic. (G. Lyell), Jan., 1906, 1 male. *Total*, 16 males, 9 females—Race *occidentalis* Tillyard, Bridgetown (Wingarrup), W.A., Jan., 1907, 11 males, 3 females. *Total*, *S. macrostigma*, 27 males, 12 females.

*S. claviculata* Tillyard—Kuranda, Q. (E. Allen), Jan., 1908, 1 male; Jan., 1910, 1 male, 1 female. *Total*, 2 males, 1 female.

*S. cyanitincta* Tillyard—Bridgetown, W.A., Jan., 1907, 1 male: Margaret River, W.A., Jan., 1907, 11 males, 2 females: Waroona, W.A. (G. F. Berthoud), Nov., 1908, 1 male, 5 females. *Total*, 13 males, 7 females. [Other locality, Armadale, W.A.].

*Metathemis guttata* Selys—Jindabyne, N.S.W., Jan., 1906, 1 male: Illawarra, N.S.W. (Lily Vale), [var. *pallida*], April, 1907, 3 males; March, 1908, 1 male—Alexandra, Vic., Dec., 1906, 8 males, 11 females. *Total*, 13 males, 11 females. [Other localities, Sydney (Hornsby), Illawarra (National Park), Blue Mts. (Leura, Medlow)].

*M. nigra* Tillyard—Kuranda, Q., Jan., 1905, 1 male, 2 females; Dec., 1906, 1 male, (F. P. Dodd); Jan., 1908, 1 female: Cairns, Q. (E. Allen), Jan., 1910, 1 male, 1 female. *Total*, 3 males, 4 females. [Other locality, Herberton, Q. (F. P. Dodd)].

*M. brevistyla* Selys—Jindabyne, N.S.W., Jan., 1906, 10 males, 8 females—Alexandra, Vic., Dec., 1906, 1 male, 2 females. *Total*, 11 males, 10 females.

*M. virgula*, Selys—Jindabyne, N.S.W., Jan., 1906, 5 males, 2 females—Alexandra, Vic., Dec., 1906, 6 males, 4 females. *Total*, 11 males, 6 females.

*Choristhemis flavoterminalis* Martin—Sydney, N.S.W. (Wahroonga), Nov., 1904, 4 males 3 females; (Duck Creek, Auburn),

Dec., 1907, 1 male; Jan., 1908, 5 males; Dec., 1908, 1 male; (Hornsby), Dec., 1909, 4 males, 4 females: Illawarra, N.S.W. (Heathcote), April, 1909, 1 male, 2 females; Dec., 1909, 7 males, 1 female—Kuranda, Q., Nov., 1906, 1 male (F. P. Dodd); Cooktown, Q., Jan., 1908, 1 male, 1 female. *Total*, 25 males, 11 females. [Other localities, Illawarra, N.S.W. (National Park), Sydney (Cheltenham), Brisbane, Q. (Enoggera Creek)].

*C. olivei* Tillyard—Cooktown, Q., Jan., 1908, 2 males.

List ii. (Mounted larvæ and exuviae).

*S. eustalacta* Burm.—Blue Mts., N.S.W. (Leura), Nov., 1908, 18 specimens.

*S. macrostigma* Selys, race *orientalis* Tillyard—Blue Mts., N.S.W. (Leura), Nov., 1908, 5 specimens; (Medlow), Nov., 1909, 2 specimens: Illawarra, N.S.W. (National Park), Nov., 1908, 17 specimens. *Total*, 24 specimens.

*S. regina* Selys—Sydney, N.S.W. (Duck Creek, Auburn), Dec., 1908, 4 specimens; March, 1909, 1 specimen. *Total*, 5 specimens.

*Metathemis guttata* Selys—Blue Mts., N.S.W. (Leura), Nov., 1908, 6 specimens; (Medlow), Nov., 1909, 2 specimens; Sydney, N.S.W. (Hornsby), Dec., 1909, 1 specimen. *Total*, 9 specimens.

*Choristhemis flavoterminalis* Martin—Illawarra, N.S.W. (Heathcote), Dec., 1909, 6 specimens; Sydney, N.S.W. (Cheltenham), Dec., 1909, 9 specimens; (Hornsby), Nov., 1909, 1 specimen. *Total*, 16 specimens.

EXPLANATION OF PLATES IV.-IX.

Plate iv. (all figs.  $\times 2$ ).

Fig. 1.—*Synthemis eustalacta* Burm. ♂.

Fig. 2.—*Synthemis tasmanica*, n.sp. ♂.

Fig. 3.—*Synthemis regina* Selys ♂.

Fig. 4.—*Synthemis leachii* Selys ♂.

Fig. 5.—*Synthemis macrostigma* Selys ♂.

Fig. 6.—*Synthemis claviculata* Tillyard ♂.



Plate v.(all figs.  $\times 2$ ).Fig.7.—*Synthemis cyanitincta* Tillyard ♂.Fig.8.—*Metathemis guttata* Selys ♂.Fig.9.—*Metathemis nigra* Tillyard ♂.Fig.10.—*Metathemis brevistyla* Selys ♂.Fig.11.—*Metathemis virgula* Selys ♂.Fig.12.—*Choristhemis flavoterminalata* Martin ♂.Fig.13.—*Choristhemis olivei* Tillyard ♂.

Small figures—top, head seen from in front; second, colour-scheme of side of thorax.

Plate vi.(wing-venation; all figs.  $\times 9$ ).Fig.1.—*Choristhemis olivei* ♂ hindwing; anal loop, arculus and triangle.Fig.2.— „ *flavoterminalata* ♂ „ „ „ „Fig.3.—*Synthemis eustalacta* ♂ „ „ „ „Fig.4.—*Synthemis eustalacta* ♀ „ „ „ „Fig.5.—*Synthemis cyanitincta* ♂ „ „ „ „Fig.6.—*Metathemis guttata* ♂ „ „ „ „Fig.7.—*Synthemis macrostigma* ♂ „ „ „ „Fig.8.—*Synthemis macrostigma* ♀ „ „ „ „Fig.9.—*Synthemis regina* ♂ „ „ „ „Fig.10.—*Synthemis regina* ♀ „ „ „ „Fig.11.—*Synthemis leachii* ♂, freak-venation of forewing in region of triangle.Fig.12.—*Synthemis cyanitincta* ♀, freak-venation of forewing in region of triangle.Fig.13.—*Synthemis regina* ♂, pterostigma.Fig.14.—*Synthemis claviculata* ♂, pterostigma.Fig.15.—*Synthemis macrostigma* ♂, pterostigma.Fig.16.—*Synthemis regina*, freak-venation of hindwing in region of triangle.

A, anal vein; arc., arculus; b, brace; C, costal vein; Cu., cubitus; h, hypertrigonal space; m, membranule; P, pterostigma; R+M, radius + median; t, triangle.

Plate vii.(appendages, etc., figs. 1-23,  $\times 9$ ).Fig.1.—*Synthemis eustalacta* ♂, anal appendages, a dorsal, b profile view.Fig.2.—*Synthemis tasmanica* ♂ „ „ „Fig.3.—*Synthemis regina* ♂ „ „ „Fig.4.—*Synthemis macrostigma* ♂ „ „ „Fig.5.—*Synthemis leachii* ♂ „ „ „Fig.6.—*Synthemis claviculata* ♂ „ „ „Fig.7.—*Synthemis primigenia* ♂ „ „ (after Martin).

- Fig. 8.—*Synthemis cyanitincta* ♂, anal appendages, *a* dorsal, *b* profile view.  
 Fig. 9.—*Metathemis brevistyla* ♂                   "                   "                   "  
 Fig. 10.—*Metathemis virgula* ♂                   "                   "                   "  
 Fig. 11.—*Metathemis guttata* ♂                   "                   "                   "  
 Fig. 12.—*Metathemis nigra* ♂                   "                   "                   "  
 Fig. 13.—*Choristhemis flavoterminalis* ♂                   "                   "                   "  
 Fig. 14.—*Choristhemis olivei* ♂                   "                   "                   "  
 Fig. 15.—*Choristhemis flavoterminalis* ♂, profile view of segment 2, underside.  
 Fig. 16.—*Synthemis regina* ♀, last three segments of abdomen, *a* profile,  
                   *b* ventral view.  
 Fig. 17.—*Synthemis macrostigma* ♀, last three segments of abdomen, profile  
                   view.  
 Fig. 18.—*Synthemis leachii* ♀, last three segments of abdomen, profile view.  
 Fig. 19.—*Synthemis eustalacta* ♀                   "                   "                   "  
 Fig. 20.—*Synthemis tasmanica* ♀                   "                   "                   "  
 Fig. 21.—*Synthemis cyanitincta* ♀, last three segments of abdomen, *a* profile,  
                   *b* ventral view.  
 Fig. 22.—*Choristhemis flavoterminalis* ♀, last three segments of abdomen;  
                   *a, b, c*, profile views of three different females; *d*, ventral view of *a*.  
 Fig. 23.—*Metathemis virgula* ♀, last three segments of abdomen, ventral  
                   view.  
 Fig. 24.—*Synthemis eustalacta* ♂, penis (× 25).  
 Fig. 25.—*Metathemis guttata* ♂, penis                   "  
 Fig. 26.—*Choristhemis flavoterminalis* ♂, penis (× 25).

## Plate viii. (larvæ).

- Fig. 1.—Part of egg-cluster of *Synthemis eustalacta* Selys (× 10).  
 Fig. 2.—Full-grown nymph of *Synthemis eustalacta* Selys (× 4).  
 Fig. 3.—Head of *Synthemis eustalacta* Selys, seen from in front (× 9).  
 Fig. 4.—Antennæ of *Synthemis eustalacta* Selys (× 25).  
 Fig. 5.—Head of *Metathemis guttata* Selys, from above (× 9).

## Plate ix. (labia of nymphs).

- Fig. 1.—Labium of *Synthemis eustalacta* Selys (× 25).  
 Fig. 2.—Labium of *Synthemis regina* Selys (× 25).  
 Fig. 3.—Labium of *Synthemis macrostigma* Selys (× 25).  
 Fig. 4.—Labium of *Metathemis guttata* Selys (× 25).  
 Fig. 5.—Labium of *Choristhemis flavoterminalis* Martin (× 25).

## STUDIES IN AUSTRALIAN ENTOMOLOGY.

No. xvi. NEW SPECIES OF CARABIDÆ.

BY THOMAS G. SLOANE.

*(Continued from Vol. xxxii., p. 381, 1907.)*

Subfamily CARABINÆ.

Tribe Migadopini.

STICHONOTUS, n.g.

*Head* short, convex, wide at base and deeply set into prothorax, strongly bordered on each side above base of antennæ; one supra-orbital setigerous puncture near eye on each side; eyes not prominent. *Labrum* emarginate-truncate, 6-setose, outer seta near anterior angle stronger than others, rising from a large conspicuous puncture; anterior angles a little advanced, rounded. *Clypeus* short, emarginate; a setigerous puncture on each side. *Mentum* short, broad, with a median tooth. *Mandibles* stout, short, without a seta in outer scrobe. *Maxillary palpi* with apical joint stout, elongate-oval, obtuse at apex. *Labial palpi* with penultimate joint bisetose in front; apical joint stout, oval, obtuse at apex. *Antennæ* slender, reaching behind base of prothorax; four basal joints glabrous, first stout, bearing a seta, fourth shortest, third longer than second, about as long as fifth. *Prothorax* closely applied to elytra, wide at base, strongly narrowed to apex; anterior and posterior angles triangular, pointed; lateral margins without setæ. *Elytra* shortly truncate-oval, bordered at base, striate; second\* and third striae uniting

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\* The second stria (counting at the base) is evidently a false stria representing the short striae so often found at the base of the first interstices in the *Carabida*. In *Stichonotus leai* it is unusually prolonged, and reaches to the apical third of the elytra. A similar conformation of the elytral striae may be found in *Amarotypus edwardsi* Bates, a New Zealand representative of the tribe Migadopini.

at base and rising from a punctiform impression a little distance behind basal border; third interstice impunctate, ninth(counting near apex) seriate-punctate; margin not interrupted near apex. *Prosternum* with anterior coxal cavities closed; intercoxal part concave, produced a little at base; basal declivity narrow, abrupt. *Mesosternum* narrow and longitudinally channelled between intermediate coxæ; mesepimeron reaching coxa. *Metasternal episterna* short, wide. *Scutellum* short, wide, obtusely rounded behind. Legs short; anterior tibiæ incrassate with six or seven short spines along outer side, inner side deeply emarginate before apex, inner spur remote from apex; anterior tarsi short, four basal joints wide, posterior tarsi slender, joints 1-4 successively shorter, first as long as three succeeding joints together.

STICHONOTUS LEAI, n.sp.

Oval, convex, nitid. Piceous; prothorax and elytra with wide ferruginous margins; scutellum and part of elytra adjoining reddish; elytra with disc generally piceous, apical and lateral declivities generally ferruginous (first interstice brown, the brown tint reaching almost to apex; eighth and ninth interstices and lateral channel wholly ferruginous, seventh interstice piceous at base and in middle of length, sixth interstice reddish except near base, fifth reddish for a short distance a little behind base); undersurface piceous, inflexed borders of prothorax and elytra ferruginous; legs, antennæ, and mouth-parts ferruginous.

Head smooth, large (1.5 mm. across eyes), convex; clypeal suture distinct. Prothorax transverse (1.45 x 2.9 mm.), widest at base, strongly narrowed to apex (1.7 mm.); sides lightly rounded; apex widely emarginate; anterior angles pointed, advanced in a short triangular prominence; base lightly sinuate on each side; basal angles sharp, triangular; margins ferruginous, very wide, but declivous, posteriorly; border well developed and equal on sides, weak, but continuous, along anterior margin, obsolete on base; a light fovea on each side of base opposite third stria of elytra; median line lightly impressed, reaching base. Elytra wide, short (3.8 x 3 mm.), convex; striæ entire, finely crenulate,

second (counting at base) obsolete on basal declivity; interstices lightly convex, ninth (counting at apex) narrow, merging with margin near base. Length 6, breadth 3 mm.

*Hab.*—Tasmania: Magnet (Colls. Lea and Sloane).

My description is founded on a single specimen given to me by Mr. A. M. Lea. It is a remarkable species, with the facies of an Oodes, and apparently has no resemblance to any other member of the tribe *Migadopini*. Its discovery brings this tribe into the Australian fauna, and so leaves little doubt but that *Nebriossoma* is a genus thereof.

#### Subfamily HARPALINÆ.

#### Tribe Broscini.

#### Genus GNATHOXYA.

#### GNATHOXYA SULCICOLLIS, n.sp.

Robust, convex; front and clypeus deeply biimpressed; prothorax subparallel on sides, strongly constricted near base, not bordered on base, a deep wide marginal sulcus along each side; elytra ovate, seriatly punctate-foveate; anterior tibiae 3-dentate externally above apex; prosternum glabrous in front of coxae, intercoxal part wide, longitudinally concave in middle, truncate behind, setigero-punctate on each side. Black, upper surface with light bronzy reflections.

Head large (3.3 × 3.9 mm.), smooth, convex, transversely impressed on a level with base of eyes; front a little raised above plane of vertex; frontal spaces convex, lateral ones tapering anteriorly; frontal sulci deep, wide, parallel, extending from opposite middle of eyes nearly to anterior margin of clypeus; a deep stria extending obliquely forward at each side from eye to base of clypeus and dividing the supra-antennal plates from the lateral frontal spaces; clypeal suture deeply impressed across median frontal space; clypeus declivous to labrum, truncate, very deeply longitudinally fossulate in middle; a puncture on each side at anterior extremity of frontal sulci; eyes round, convex.

Labrum concave, longitudinally striate in middle; anterior margin emarginate, widely rounded at each side, sexsetose (the two middle setae very close together, rising from small punctures). Prothorax longer than broad ( $6.2 \times 5.8$  mm.), convex, truncate at base and apex; a wide basal area sharply constricted on each side and depressed below plane of disc; sides subparallel (a little rounded in middle), shortly, roundly and decidedly narrowed to apex, sharply narrowed posteriorly and meeting base at right angles; lateral border narrow, extending from anterior to basal angles; base not bordered or upturned; a deep wide marginal sulcus along each side, extending from a little behind anterior angle nearly to beginning of basal constriction; lower side of marginal sulcus defined by lateral border of prothorax, upper side convex, arcuate; a lightly impressed wide curved impression, (with a fovea in middle), a little above marginal sulcus, and extending from basal area to anterior angle; median line strongly impressed. Elytra wide ( $11 \times 7.7$  mm.), convex, declivous to peduncle, subparallel on sides, widely rounded on base, gently but decidedly inflated on each side of peduncle; humeral angles not marked; apical declivity roughly granulate; four rows of punctate foveae on each elytron, (first row narrow, second row consisting of three or four wide punctate depressions a considerable distance from base, third row consisting of three or four wider and more elongate depressions, fourth row more irregular); about five widely placed umbilicate setigerous punctures placed in wide depressions near lateral margins, in front of apical granulate part; lateral border narrow. Ventral segments 3-5 with a narrow coriaceous border along posterior margin, bipunctate on each side of middle. Posterior trochanters short, thick, reniform, plurisetose on posterior margin; femora thick, swollen in middle, posterior with an arcuate double row of setigerous punctures from near base to apex; anterior tibiae with a long wide laminate external spur at apex, external edge strongly 3-dentate above apex, upper tooth triangular; shorter than others; intermediate tibiae short, stout, incrassate with a strong external spur at apex; posterior tibiae much longer than femora, slightly incrassate at apex. Length 20, breadth 7.7 mm.

*Hab.*—Central Australia (Coll. Sloane). Given to me by Mr. C. French, who sent me also a second specimen, 15 mm. in length, ticketed Esperance Bay.

A distinct species, showing more resemblance to *Gn. insignitus* MacL., than to any other described species, but differing conspicuously by larger prothorax with lateral sulci, and without a channel along base; anterior tibiae 4-dentate; posterior femora and coxae with numerous setigerous punctures, etc.

### Genus BRITHYSTERNUM.

#### BRITHYSTERNUM MACLEAYI, n.sp.

♂. Elongate, robust, laevigate. Elytra widely rounded at apex, lateral margins with a wide triangular explanate process on each side about posterior third; intercoxal part of prosternum produced backwards in a long process excised at apex; intermediate femora armed a little before apex on lower side with a long stout slightly hooked spur; anterior tibiae with a thick obtuse triangular prominence on lower side a little above middle. Black, nitid.

Head large, convex; eyes small, not inclosed at base; subocular ridge well developed; clypeus bipunctate on each side, anterior margin truncate. Labrum emarginate, anterior angles rounded. Labial palpi stout; penultimate joint short with four or five setae on anterior margin; apical joint a little longer than penultimate, thick, a little compressed, truncate. Prothorax a little longer than broad (9.5 x 9 mm.), subdepressed on disc, widest before middle, lightly narrowed to base; apex truncate (hardly emarginate); anterior angles very little advanced, obtuse; base truncate, not bordered, except near each side; basal angles rectangular, obtuse at summit; lateral border narrow, hardly wider at anterior angles, subsinuate (but not wider) near base; lateral channel narrow with four or five punctures along its course; median line distinct; a well-marked transverse impression a little before base. Elytra oval (17.5 x 8.6 mm.), convex, declivous to peduncle; lateral declivities abruptly rounded; apex strongly declivous; sides with

a wide triangular explanate process about posterior third, this process lightly reflexed and obtuse at apex; border extending obliquely downwards from humeral angles and almost meeting border of inflexed margins at lateral processes. Posterior trochanters cordiform, not long; apex a little curved inwards, obtusely pointed: intermediate femora wide towards apex, armed on inner edge of lower side a little before apex with a long curved spur-like process;\* posterior elongate, not swollen in middle: anterior tibiae thick, bent; upper side widely sinuate in middle; lower side with a strongly raised, wide, obtuse protuberance opposite middle of sinuosity of upper side. Length 32, breadth 8.6 mm.

*Hab.*—Northern Territory of South Australia (Coll. French).

In many ways, this species and the following are the most singular Carabs I have seen, and are very different from *B. calcaratum* MacL., by the explanate lateral processes of the elytra. In *B. macleayi* the lateral processes of the elytra project 1.5 mm. from the sides, so that the width of the elytra is 11.6 mm., if measured at these prominences. The backward prolongation of the prosternum is 3 mm. in length, subcylindrical, a little wider, and triangularly excised, at the point. The antennae are more elongate than in *B. calcaratum*, and are glabrous, with a setulose flattened space on lower side near apex of those after the fourth.

*Note.*—The description given above was founded on a single specimen in the French Collection (now in the National Museum, Melbourne). More recently Mr. French has received a number of specimens, of both sexes, from the Pine Creek District of the Northern Territory; these are smaller and present some minor differences from the original specimen. I offer the following note on these specimens:—

♀. Differs from ♂ by prothorax shorter, wider; sides more rounded; anterior angles more prominent. Elytra much wider,

\* In Pine Creek specimens this femoral tooth is a stout triangular dentiform process.



without lateral processes, border a little thickened at position of these processes. Intercoxal process of prosternum much shorter (in ♂ the intercoxal process is variable in length, and sometimes has the apex obtusely rounded, not bifid or excised). Anterior tibiae shorter, and without median process of lower side. Dimensions: ♂. Length 26, head across eyes 5, prothorax  $7.7 \times 6.8$ ; elytra  $14.5 \times 7$ , across lateral processes 9.5; ♀. length 24-26, head across eyes 5.1, prothorax  $6.5 \times 6.7$ , elytra  $15.8 \times 9$  mm.

*BRITHYSTERNUM NODOSUM*, n.sp.

♂. Elongate, robust, laevigate. Elytra with a wide lateral plica on each side, extending obliquely upwards and backwards from lateral border just before apical curve. Prosternum with a large nodule on each side a little behind anterior margin and with its outer margin touching episternal suture; intercoxal part wide, flat, deeply and roundly excised at base, the sides of this excision produced backwards to form two obtuse prominent horns. Anterior legs unarmed; intermediate femora with a long horn projecting at right angles from lower side. Black, nitid.

Head large, convex (6 mm. across eyes), front lightly and widely bi-impressed between antennae; eyes small, convex, not inclosed at base; subocular ridge well developed. Labrum longitudinally sulcate in middle, emarginate; angles rounded. Labial palpi stout; penultimate joint short, with four or five setae on anterior margin; apical joint a little longer than penultimate, thick, truncate, narrowed to base, arcuate on outer side: maxillary palpi with penultimate joint very short, triangular; apical joint similar to that of labial but not narrowed to base or arcuate on outer side. Prothorax longer than broad ( $10 \times 7.9$  mm.), convex (disc subdepressed, nitid, with faint transverse striolae); base and apex of about equal width (6.2 mm.); sides almost parallel in middle, very lightly narrowed posteriorly; a light sinuosity about 1.5 mm. before base; anterior margin sinuate-truncate; anterior angles strongly advanced, obtuse at apex; base truncate; basal angles decidedly produced backwards in a short obtuse prominence; lateral border thick, lightly reflexed, a little

inturned just before base; lateral channel narrow, a little exaplate near anterior angles, unipunctate (the puncture 2.5 mm. from anterior angles); median line well-marked; a distinct transverse impression a little before base—between sinuities of lateral border. Elytra oval (17 × 9.5 mm.), parallel on sides, convex, sloping very gently to peduncle; surface subopaque owing to numerous faint scratches; an elongate-oblique lateral process on each side, just behind middle, this process forming a strong plica rising opposite beginning of apical curve (about 1.25 mm. above border of elytra) and extending forward about 3 mm. to join the border; lateral border narrow, sinuate about middle of lateral process; each side with four or five submarginal punctures along anterior third, and with three similar punctures along apical curve, another similar puncture in the concavity between the lateral border and the plica. Ventral segments convex, rugulose, impunctate; apical segment smooth, except near sides, unipunctate on each side of apex. Posterior trochanters very short; apex wide, roundly truncate: femora rather long; anterior not swollen in middle, lightly incrassate to apex; intermediate shorter than anterior, swollen towards apex, armed on lower side with a long stout straight horn (length 2 mm.); posterior narrow, not swollen on lower side, upper side subcarinate towards base: four anterior tibiae a little bent, stout at apex; posterior long, slender, lightly incrassate, curving lightly backwards: tarsi short, posterior with first joint about one-half longer than second; apical joint stout, cylindrical, hardly narrowed to base. Length 30, breadth 9.5 mm.

♀. Differing greatly from ♂, smaller, more robust. Prothorax shorter (7.6 × 7 mm.); basal angles less produced backwards. Elytra much shorter (15 × 9 mm.), more convex and without lateral processes. Prosternum with lateral nodules much less developed; intercoxal part somewhat similar but less developed, almost equally emarginate at base. Legs unarmed; four anterior tibiae not curved; posterior trochanters ovate, obtusely rounded at apex (not widely truncate); posterior tarsi narrower with basal joint longer. Length 24 mm.

*Hab.*—Roebuck Bay District[Colls. French(♂) and Sloane(♀)]. Sent by Mr. C. French, who presented me with a specimen, as coming from N. W. Australia, towards Roebuck Bay.

Comparing the ♂, it differs from *B. macleayi* Sl., by prothorax narrower, less narrowed to base; the strongly developed pectoral nodes (in *B. macleayi* there is only a slight protuberance on each side representing the pectoral nodules); intercoxal part of prosternum short, not greatly prolonged; elytra broader, with the lateral processes far less prominent and not triangularly pointed, etc.

Female specimens of the three species of *Brithystrum* are before me, and may be tabulated as under :—

- A. Prosternum without pectoral nodes, intercoxal part produced backwards, this backward prolongation narrowed and notched behind. Posterior trochanters cordate.
- B. Prothorax with anterior angles wide, obtuse, prominent.  
Elytral border not decidedly thickened at posterior third.  
Posterior trochanters elongate-cordate.....*B. calcaratum* MacI.
- BB. Prothorax with anterior angles narrow, subprominent.  
Elytral border decidedly thickened at posterior third.  
Posterior trochanters short.....*B. macleayi* Sl.
- AA. Prosternum with a nodule on each side placed a little behind anterior margin in front of coxæ; intercoxal part wide and deeply emarginate behind, its sides parallel. Posterior trochanters short, oviform.....*B. nodosum* Sl.

### Tribe Harpalini.

#### Genus PHORTICOSOMUS.

#### PHORTICOSOMUS ZABROIDES, n.sp.

♂. Elliptical-oval, robust, convex; mandibles longitudinally strigose near inner margin of upper side; prothorax transverse, wider at base(5 mm.) than at apex(3.8 mm.), anterior and basal angles widely obtuse; elytra subparallel on sides, strongly simply striate, base wide with angles rounded, interstices convex, second with a strong elongate striole at base, third impunctate; anterior and intermediate coxæ, prosternum, mesosternum, and meta-

thorax more or less setose; middle part of ventral segments 2-5 setigerous. Antennæ with third joint one-half longer than second, setose only on the swollen anterior third. Labial palpi with penultimate joint plurisetose; apical joint fusiform, bearing a few fine long setæ on each side. Labrum lightly emarginate. Black, under surface and legs piceous-brown.

Head large, convex (3.5 mm. across eyes); clypeal suture distinct; front foveate on each side between bases of antennæ; eyes small, convex. Prothorax wide (4 × 5.5 mm.), convex, lightly rounded on sides, very little narrowed to base; anterior angles wide, not marked; base truncate; basal angles hardly marked, wide; border obsolete, or almost so, on middle of apex and base, wide and reflexed on sides; median line lightly impressed; a short rugose fovea on each side of base, space between these foveæ longitudinally strigose. Elytra not greatly wider than prothorax (9.3 × 6.1 mm.), strongly declivous on sides; base wide, truncate; apical curve oblique on each side; ninth interstice depressed, wider and impunctate on middle part of course; border reflexed on sides, curving widely round humeral angles. Prosternum (including antecoxal part) setigero-punctate; mesosternum between coxæ, and on each side, setulose-punctate; metathorax on each side behind intermediate coxæ strongly setigero-punctate. Anterior trochanters plurisetose on anterior side and with one long seta on lower side: posterior trochanters reniform, obtuse at apex, glabrous (except just beside coxæ), a single conspicuous setigerous puncture on inner side near base: femora short, swollen in middle; posterior femora short; a row of setigerous punctures along lower margin of anterior side; four anterior tibiæ wide at apex: anterior tibiæ with a stout dentiform apical projection on lower side beside insertion of tarsi; external margin with two small teeth above the dilatate triangular apical projection; intermediate tibiæ with outer side arcuate, denticulate; apex dilated into a strong triangular process; posterior tibiæ slender, a little dilated at apex: anterior tarsi short, without squamulæ beneath. Length 14.5, breadth 6.1 mm.

*Hab.*—Queensland: Burketown District (Coll. Sloane; unique).

The type-specimen of this strange species was given to me by Mr. C. French many years ago, as coming from the Gulf of Carpentaria, opposite the Wellesley Islands. It has no resemblance to any other species of *Phorticosomus*, being far more convex, and with the prothorax much less narrowed posteriorly. *P. zabroides* resembles the European *Zabrus tenebrioides* Goeze, so closely in size, shape, and appearance that one's first impression is that a species of *Zabrus* is before him; but it differs from *Z. tenebrioides* by elytra with humeral angles not marked, margin not interrupted posteriorly, etc.

Tribe Trigonotomini.

Genus NURIDIUS.

NURIDIUS GRANDIS, n.sp.

Broad, robust, convex; head large(8.7 mm. across eyes), paragenæ widely dilatate behind base of mandibles, with anterior angles widely rounded, two supraorbital setæ on each side, clypeus plurisetose, mandibles plurisetose in basal concavity of outer side; prothorax subquadrate, widest at anterior fourth, base and apex of equal width(9 mm.), base widely depressed and fringed with hair; elytra truncate-oval, lightly and evenly rounded on sides, finely punctate-striate, interstices convex, third 2-punctate on apical half, base not bordered, humeral angles dentiform; prosternum (including middle of antecoxal part) setigero-punctate; intercoxal part of mesosternum sparsely setigero-punctate; metasternum setigero-punctate behind the transverse suture; intermediate and posterior coxæ plurisetose, posterior trochanters reniform, short, obtuse at apex, plurisetose. Black; head, prothorax, and undersurface nitid; elytra opaque, base and scutellum nitid, lateral margins(including ninth interstice) nitid and seriate-punctate on inner side.

Head thick, convex, slightly inflated behind and below eyes; frontal impressions wide, deep, short; eyes small, round, convex, not inclosed behind. Labrum rounded, sexsetose. Clypeus lightly emarginate; about six irregularly placed setigerous punc-

tures on anterior half from side to side. Mandibles long; outer side finely setigero-punctate (about twelve setæ) in juxta-antennal channel. Prothorax broader than long (7.5 × 11 mm.), lightly convex, declivous on anterior three-fourths and posteriorly to basal depression; sides lightly rounded on anterior two-thirds, lightly obliquely narrowed posteriorly; apex lightly and widely emarginate; anterior angles not advanced, obtusely rounded; base emarginate; basal angles widely obtuse; lateral border wide, lightly reflexed posteriorly; median line lightly impressed; lateral basal impressions short, wide, distinct, connected by a wide basal depression; posterior marginal seta placed beside lateral border a little before basal angle; base with a marginal hair-fringe above peduncle. Elytra much wider than prothorax (22 × 15.4 mm.), lightly and evenly convex, wide across base, evenly rounded on sides, widely rounded without sinuosities at apex; interstices finely shagreened, 1-7 convex, subcostate, third, fifth, and seventh costiform and slightly more prominent than the others, eighth depressed; border reflexed, less strongly so behind shoulders; striae at base of first interstice represented by a fine oblique scratch; anterior puncture of third interstice placed a little behind middle, posterior puncture about 3.5 mm. from apex of interstice. Peduncle wide. Scutellum very wide and short. Prosternum with a wide deep intercoxal channel, this channel not reaching base. Metasternum with a wide deep longitudinal channel; episterna short, declivous to epimera, bordered along anterior, inner, and posterior sides. Ventral segments 2-6 setigero-punctate; second with a few punctures on each side near trochanters; sixth with a few fine setæ on each side; third, fourth, and fifth with numerous punctures scattered over their surfaces, except near sides and (in a general way) near anterior margins. Length 39, breadth 15.4 mm.

*Hab.*—Queensland: Blackall Range (Hacker).

I owe a single specimen of this remarkable species to the kindness of Mr. Henry Hacker. Its much greater size distinguishes it from *N. fortis* Sl. It is evidently not *Nurus niger* Chaud., which is described as having no vestige of a tooth at the shoulders.

of the elytra, where *the basal border blends* with that of the sides. It is extraordinary to find in this species, a Trigonotomid with the outer scrobe of the mandibles setose.

### Genus NOTONOMUS.

#### NOTONOMUS BANKSI, n.sp.

♂. Elongate-oval, convex; head large (4.2 mm. across eyes); prothorax almost as long as broad, not sinuate on sides near base, apex and base of equal width (4 mm.), basal angles obtuse, posterior marginal puncture on border just before basal angles; elytra deeply striate, interstices convex, third 4-punctate (posterior puncture on apical declivity), eighth not convex, wide, not wider than ninth, except near base, basal border not dentate at humeral angles; intercoxal declivity of prosternum rounded, narrow in middle; metasternum, with episterna, short. Tarsi not striolate on upper surface, onychium glabrous beneath. Head and prothorax shining bronzy-green; elytra æneous-bronze; under surface, mandibles, and labrum black; anterior ventral segments subviridescent laterally; legs, antennæ, and mouth-parts piceous-red.

Head convex; front strongly biimpressed; eyes, with orbits, prominent. Mandibles decussating. Prothorax long, narrow (5.3 × 5.5 mm.), widest before middle, strongly declivous to anterior angles; sides lightly rounded, obliquely narrowed to base, strongly rounded to apex; anterior angles obtuse, not marked; base lightly emarginate in middle; basal angles hardly marked; border narrow, extending round basal angles on to base on each side; median line lightly marked; lateral basal impressions narrow, deep near base, extending lightly forward in an outcurved course. Elytra oval (13 × 7 mm.), convex; sides lightly rounded; lateral apical sinuities well-marked, but shallow; basal border joining lateral border at humeral angles without interruption, but inner angle decidedly marked; lateral border narrow; striæ simple; interstices strongly and roundly convex, not carinate on apical declivity, tenth well-developed and extending forward to about one-half the length of elytra. Mesosternum

with intercoxal declivity concave. Legs stout; (femora thick, swollen in middle). Length 22, breadth 7 mm.

*Hab.*—N.S.W.: Eden (H. J. Carter; January, 1910). Colls. Carter and Sloane).

A single specimen of this fine species was given to me by Mr. H. J. Carter. It is allied to *N. variicollis* Chaud., from which it differs by colour (head and prothorax not black, etc.); prothorax with anterior angles less decidedly marked and more closely applied to neck, basal angles much more rounded, not distinctly marked; elytra with basal border less raised, particularly at humeral angles, these less marked, eighth interstice wider and less convex, ninth interstice much wider, etc.

*NOTONOMUS FERGUSONI*, n.sp.

Oval, robust; head large (3.2 mm. across eyes); prothorax broader than long, basal angles rounded; elytra truncate-oval, strongly striate, interstices convex in ♂, lightly so in ♀, third 2-punctate; intercoxal declivity of prosternum narrowed and rounded in middle, of mesosternum lightly concave. Black

♂. Head convex; frontal impressions feebly marked behind clypeal suture. Prothorax suborbiculate (3.3 × 4.3 mm.), much wider at apex (3.4 mm) than at base (2.8 mm.); sides strongly rounded; basal angles widely rounded; border wide, passing round basal angles to lateral basal impressions; posterior marginal puncture on border at basal angle; median line well-marked; lateral basal impressions deep, not long or wide. Elytra ovate (7.6 × 4.8 mm.), lightly convex on disc, strongly declivous to apex, strongly sinuate on each side of apex; basal border strongly raised, joining lateral border at humeral angles without interruption, but inner angle sharply marked; lateral border strongly reflexed and carinate near base; third, fifth, and seventh interstices wider than others, eighth much wider than ninth on basal half, tenth shortly developed in front of apical sinuosity. Length 15, breadth 4.8 mm.

*Hab.*—N.S.W.: Lindfield (a suburb of Sydney). Colls. Carter, Ferguson, and Sloane.



The position of this species in the genus *Notonomus* is next *N. sydneyensis* Sl., from which it differs by colour wholly black, without metallic reflections; head larger; prothorax shorter, more rounded on sides and at posterior angles. It also has some affinity to *N. scotti* Sl., but is very distinct, some conspicuous differences being its smaller size; larger head; prothorax shorter, more strongly rounded on sides and at basal angles, lateral border wider; elytra less convex, more deeply striate; basal and lateral borders much more strongly raised at point of junction. It was discovered by Dr. E. W. Ferguson, about two miles east from the Lindfield Railway Station (seven miles from Sydney on the North Shore Railway) where I have also taken it.

Genus CHLÆNIOIDIUS.

CHLÆNIOIDIUS INTERSTITIALIS, n.sp.

Elliptical-oval, subdepressed; prothorax subquadrate, sides lightly sinuate posteriorly, basal angles rectangular, with summit obtuse; elytra crenulate-striate, interstices convex, first with stria at base, third impunctate; intercoxal part of prosternum not bordered. Brown.

Head convex (3 mm. across eyes), minutely punctulate; two short light impressions between bases of antennæ; eyes convex, inclosed behind. Prothorax broader than long (3.4 × 4.5 mm.), depressed, much wider at base (4.25 mm.) than at apex (3.2 mm.); minutely punctulate (punctulation stronger in lateral basal impressions); sides lightly arcuate on anterior three-fourths, meeting base at right angles; anterior margin hardly emarginate; anterior angles not marked; base truncate on each side, lightly emarginate in middle; border wide on sides, extending along base on each side, narrow and entire on anterior margin; median line finely impressed on disc; lateral basal impressions wide, shallow; posterior marginal seta at basal angle (in the angle of the border). Elytra wider than prothorax (9.7 × 6.25 mm.); striae strongly impressed, crenulate; interstices convex, minutely punctate, ninth narrow, finely rugulose, seriate-punctate; apical curve sinuate on each side; marginal channel wide; lateral border lightly reflexed.

Posterior trochanters impunctate. Length 14-16, breadth 6-6.25 mm.

*Hab.*—North-West Australia. Sent to me by Mr. C. French, as from the Ashburton River. Coll Sloane.

Differs from the other dark-coloured species of *Chlaenoidius* by the sharply-marked posterior angles of the prothorax. It is readily distinguished from *C. proluxa* Erichs., by prothorax more depressed, wider in front, sides sinuate posteriorly, basal angles more sharply marked, lateral basal impression much shallower; elytra with interstices convex; posterior trochanters not bearing a setigerous puncture, etc.; from *C. pectiloides* Chaud., it differs by prothorax longer, less strongly rounded on sides, less strongly narrowed posteriorly, wider across base, basal angles more sharply marked.

*Note.*—The brown colour would serve to differentiate it from all the other species, but possibly this may be due to the immaturity of the specimens before me.

#### Genus SETALIMORPHUS.

##### SETALIMORPHUS REGULARIS, n.sp.

♂. Robust, elliptical, parallel on sides; prothorax lævigate, subquadrate, widest before middle, sides unisetigerous at anterior third; elytra strongly simply striate, humeral angles dentate, interstices convex, third unipunctate a little behind middle; metepisterna subquadrate (but, including epimera not broader than long). Black, antennæ and mouth-parts ferruginous, legs piceous-red.

Head convex, wide (1.5 mm. across eyes), sharply constricted to a wide neck behind eyes; front bilimpresed, impressions wide apart, arcuate, diverging backwards, extending forward to anterior margin of clypeus; vertex transversely impressed on each side behind posterior supraorbital puncture; eyes convex, not roundly prominent, strongly inclosed in orbits behind. Prothorax broader than long (2 × 2.65 mm.), depressed on disc, declivous to sides on anterior two-thirds; base much wider (2.35 mm.) than apex (1.7 mm.); sides very lightly rounded on

anterior half, very slightly and obliquely narrowed posteriorly; apex lightly and widely roundly emarginate; anterior angles obtuse, distant from neck; base emarginate in middle, truncate on each side; basal angles subrectangular (a little obtuse at summit); lateral border narrow; lateral channel narrow, ending at basal angles; median line lightly marked; two lightly impressed impunctate basal impressions on each side, inner impression linear, short, placed opposite fourth interstice of elytra; outer impression short, wide, shallow, opposite sixth interstice of elytra. Elytra very little wider than prothorax ( $4.1 \times 2.8$  mm.), subdepressed on disc, strongly declivous to apex and sides, lightly declivous to base on each side of scutellum, truncate at base, rounded at apex; sides almost parallel; interstices convex, 1-6 about equal on disc, 6-8 greatly narrowed to apex, seventh and eighth narrow, ninth seriate-punctate. Prosternum with intercoxal part truncate, bordered, vertical and flat on posterior declivity; episterna nitid, impunctate. Mesepisterna with a few punctures in channel. Metasternum with a strong external marginal channel; episterna impunctate, longitudinally sulcate near inner margin. Ventral segments 1-3 with a few indistinct punctures laterally, 3-6 bipunctate, transversely striate near posterior margin. Femora wide: four posterior tarsi with joints sulcate externally, fifth joint setulose beneath; anterior tarsi in ♂ dilated and biserially squamulose beneath. Length 7.2, breadth 2.8 mm.

*Hub.*—Vic.: Mordialloc (C. French, Junr.).

This species (kindly given to me by Mr. C. French) is wider and more depressed than *S. punctiventris* Sl., with head wider, eyes much less prominent and more strongly inclosed behind, frontal impressions less strongly impressed; prothorax less convex, wider, widest part more forward, sides less rounded, lateral basal impressions much weaker and not punctate, no seta at basal angle; mes- and metepisterna not strongly punctate. From *S. nanus* Sl., it is at once distinguished by its much larger size, wider form, more depressed upper surface; prothorax much more transverse, proportionately much wider at base, etc. The second

stria rises from a punctiform impression which also gives off a very short rudimentary basal stria. As in *S. nanus*, there seems to be no trace of the posterior marginal seta of the prothorax, which is present in *S. punctiventris* in the lateral channel just beside the basal angle. I believe the genus *Setalimorphus* is apterous. The discovery of *S. regularis*, which is in many ways intermediate between *S. punctiventris* and *S. nanus* (= *Phenaulax stenomorpha* Tschitschérine) indicates that, contrary to my formerly expressed idea, *Phenaulax* is not entitled to recognition as even subgenerically distinct from *Setalimorphus*.\*

Tribe Odacanthini.

Genus EUDALIA.

EUDALIA CASTELNAUI, n.sp.

Black, vertex and disc of prothorax nitid. Head wider than prothorax (1.9 mm. across eyes). Prothorax hardly longer than broad (1.8 × 1.75 mm.), roundly ampliate on sides, laevigate on middle of disc, punctate anteriorly and posteriorly; base truncate; basal angles obtuse. Elytra wide (6.3 × 4 mm.), punctate-striate; interstices shagreened, glabrous, third and fifth interstices with a row of distant setigerous punctures. Length 10.5, breadth 4 mm.

*Hab.*—Victoria: ("Alpine District")—N. S. Wales: Jindabyne (Carter).

This species is at once differentiated from the other large-sized species of the genus by the glabrous interstices of the elytra; and from *E. froggatti* MacL., and *E. sublaevis* MacL., by its much larger size. It is nearest *E. nigra* Sl., but is easily distinguished from that species by legs entirely black; head smoother, less setose behind eyes; prothorax less setose, more convex, less ampliate on sides, border less strongly developed, basal angles less marked; elytra glabrous; sides of mesosternum and metasternum more sparingly and less strongly punctate; second ventral segment with only a few punctures on each side near anterior margin, etc.

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\* These Proceedings, 1907, p. 368.

I first received this species, in 1904, from Mr. C. French; subsequently (January, 1906) Mr. H. J. Carter took it plentifully on the margin of the Snowy River, at Jindabyne.

Genus *LACHNOTHORAX*.

*LACHNOTHORAX PALUSTRIS*, n.sp.

Head large, diamond-shaped, narrowly strangulate posteriorly and united to prothorax by a condyle; prothorax globose; elytra wide, with an irregular transverse impression on disc at basal third, striate, the striae entire, interstices finely setigero-punctate, tarsi with upper surface hairy, fourth joint simple. Black with an olivaceous tint (or, elytra obscurely bronzed); apical declivity of elytra obscurely tinged with brown; femora clear brown on basal two-thirds, infusate towards apex; tibiae infusate with middle third testaceous, tarsi fuscous; antennae, mandibles and palpi piceous.

Head convex (1.35 mm. across eyes), setigero-punctate, strongly constricted posteriorly, very narrow and strangulate by a transverse furrow just before base; eyes convex, prominent. Prothorax a little wider than head, longer than broad (1.75 x 1.45 mm.), convex transversely and longitudinally; sides roundly ampliate in middle, very strongly and roundly narrowed to apex, strongly and shortly narrowed posteriorly, strongly sinuate at basal fifth, meeting base at right angles; apex and base truncate; anterior angles closely applied to head; a lateral ridge on each side of pronotum; upper and under surfaces setigero-punctate; the puncturation strong beneath, finer and more sparse on upper surface; constricted basal area closely punctate; sutures of under surface obliterated; prosternal episterna ampliate, and visible from above outside lateral border of pronotum. Elytra convex, ampliate, twice as wide as prothorax (4.5 x 3 mm.), widest before middle; sides lightly rounded; base arcuate, declivous; apex widely rounded,\* striae strongly impressed, reaching to apex,

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\* It is impossible to regard the apex of this species as that of a *Truncatipennis*, it being rounded in an even curve, without even the usual apical sinuosities.

strongly punctate towards base, puncturation obsolete towards apex; interstices lightly convex near base, depressed posteriorly, finely and rather closely setigero-punctate, first interstice with a punctate stria at base very near suture; lateral channel punctate anteriorly; inflexed margins setigero-punctate. Mesosternum, metasternum, and abdomen setigero-punctate. Male with anterior tarsi not dilatate nor clothed beneath. Length 8.5, breadth 3 mm.

*Hab.*—Q.: Cairns (Anderson and Allen). Sent to me by Mr. A. M. Lea, with the information that Messrs. Anderson and Allen report it as not uncommon about salt-marshes near Cairns.

*LACHNOTHORAX FORMICOIDES*, n.sp.

Winged, form ant-like. Head wider than prothorax, narrowly stragulate posteriorly and united to prothorax by a condyle; prothorax globose; elytra wide, convex, non-striate, sparsely setose, a strong narrow transverse impression across disc at basal fourth, inflexed margins glabrous; tarsi hairy above, fourth joint entire. Piceous-black;\* antennæ, mandibles, condyle of head, lateral channel and inflexed margins of elytra, and a narrow transverse posthumeral macula testaceous-brown, at bottom of external part of transverse elytral depression, a small pale round macula on apical declivity of each elytron opposite apical sinus; legs testaceous, with apical third of femora, base and apex of tibiae and tarsi more or less infuscate.

Head wide (1 mm. across eyes), convex, glabrous; one supra-orbital seta near middle of margin of orbit and several (three or four) similar postocular setæ on each side. Antennæ slender, lightly compressed; first joint large, bisetigerous in front; second joint short; third cylindrical, sparsely setulose; fourth cylindrical, hardly shorter than third. Prothorax small, longer than broad (1 × 0.8 mm.), lævigata; disc sparsely beset with long setæ; sides roundly ampliate in middle; episterna visible from above; a transverse impression across base; a lateral ridge on each side of

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\* Two specimens before me have the colour yellowish-brown, with the disc of the elytra piceous-brown; evidently these are immature.

pronotum. Elytra smooth (except for rows of fine setæ), widely oval ( $2.25 \times 1.8$  mm.); base arcuate, declivous; apex obliquely truncate on each side, rounded in middle, a very light sinuosity just within outer angle. Length 5, breadth 1.8 mm.

*Hab.*—Port Darwin (Dodd). Coll. Sloane.

A very distinct species, differing from our other two allied species, *L. globulicollis* MacL., and *L. riverinae* Sl., by smaller size, duller colour, two pallid apical maculæ of elytra, basal part of elytra impunctate (except for the punctures from which the rows of setæ rise).

The described Australian species of *Lachnothorax* (*L. globulicollis* and *L. riverinae* were described under the genus *Casnomia*) may be tabulated as under:—

A. Pronotum punctate; elytra regularly striate; length 8.5 mm. ....  
 .. *L. palustris* Sl.

AA. Pronotum smooth with long setæ; elytra not striate (unless near base, *e.g.*, *L. riverinae*).

B. Prothorax red.

C. Elytra purplish-black, with a broad posthumeral and an apical macula red; length 7.5 mm. .... *L. globulicollis* MacL.

C. Elytra bluish-green, a single broad red fascia on apical half; length 7 mm. .... *L. riverinae* Sl.

BB. Prothorax piceous-black or brown. Elytra piceous-black, each elytron with a small posthumeral yellowish fascia, and a pallid apical macula; length 5 mm. .... *L. formicoides* Sl.

*Note.*—I believe the four species tabulated above are referable to Motschulsky's genus *Lachnothorax* (1862), and that *Lachnothorax* might well be considered a valid genus, distinct from *Casnomia*. By their facies, short globose prothorax, hairy tarsi, etc., the four species of *Lachnothorax* are thoroughly differentiated from all other Australian species which have been referred to *Casnomia*.

### Tribe Pericalini.

#### Genus CATASCOPIUS.

##### CATASCOPIUS BREVISPINOSUS, n.sp.

Elongate-oval; prothorax a little wider at base (3.25 mm.) than at apex (3.1 mm.), sides widely margined, strongly sinuate at

posterior third, two marginal setae on each side; elytra oval, lightly crenulate-striate, third interstice 3-punctate, each elytron bimucronate at apex. Head green with a slightly brassy tint; prothorax æoneous with a cupreous tinge, more marked in ♂ than in ♀; elytra chalybeous with greenish tints; under surface greenish, abdomen dark with greenish metallic tints; femora and posterior trochanters shining green, tibiae and upper side of tarsi black; mandibles and labrum black; antennae and palpi piceous.

♂. Head as in *C. chaudiæ* Cast., (3.4 mm. across eyes). Prothorax subquadrate, broader than long (2.8 × 3.7 mm.), widest and feebly subangulate at anterior marginal seta (a little before middle), lightly narrowed (obliquely at first, then roundly) to anterior angles; upper surface transversely striolate; anterior margin emarginate; anterior angles wide, prominent; base lightly truncate-emarginate above peduncle; basal angles rectangular; lateral border explanate posteriorly; a narrow depressed area across base defined by a well marked transverse impression; median line strongly impressed; anterior transverse impression well marked. Elytra rather wide (10 × 5.5 mm.); interstices subequal, very slightly convex behind basal fifth, first wide and bearing a deep striole at base, fifth convex at basal fifth, seventh much narrower than sixth or eighth and subcostate on basal fifth; each elytron armed at outer apical angle with a strong acute mucro about half a millimetre in length, and at inner apical angle with a short stout pointed mucro. Prosternum and metathorax, in middle, intermediate and posterior coxae thickly clothed with a tawny villosity. Ventral segments 2-5 pubescent in middle, apical segment a little setose in middle.

♀. With anterior angles of prothorax as in ♂. Prosternum villose, but less densely so than in ♂. Metasternum sparsely setose anteriorly. Ventral segments glabrous. Length 16.5, breadth 5.5 mm.

*Hab.*—Q.: Coen (Hacker; December and January). Two specimens of this beautiful species were given to me by Mr. Henry Hacker.





inct towards sides; apex truncate; anterior angles obtuse; base bisinuate, rather strongly rounded in middle; basal angles a little obtuse, though sharply marked; anterior marginal puncture just behind anterior angle, middle one at widest part, posterior one at basal angle; border narrow and oblique between middle and anterior punctures, roundly incurved to anterior angle before anterior puncture and continuous on each side of apex, lightly subsinuate before basal angle, continuous on base; a depressed marginal space near each basal angle. Elytra convex, wider than prothorax ( $5.5 \times 3.2$  mm.), wide at base, rounded at humeral angles, parallel on sides; lateral declivity lightly sinuate behind anterior fourth; apex produced and obtusely rounded at extremity of three inner interstices; external angle rounded, not prominent; striae strongly impressed, punctate; two anterior punctures of third interstice near third stria, first about basal fourth, second a little behind middle, posterior puncture near apex; border continuous from peduncle to inner apical angle, a little thickened at external apical angle. Length 10.3, breadth 3.2 mm.

*Hab.*—Q.: Cairns (Anderson). I am indebted to Mr. C. French's generosity for a specimen of this beautiful species.

The discovery of this species adds another to the now numerous list of Oriental genera which are known to extend to Northern Australia. It differs from the three Asiatic species described by Chaudoir, by its larger size, elytra with external angle not dentate, etc. From a New Guinea species, which I propose to describe later, it differs by its larger size; different colour (elytra not violaceous); prothorax not strongly punctate, less convex, wider at base, elytra more strongly striate, interstices convex, seventh much narrower, etc.

#### Tribe Lebtini.

#### Genus XANTHOPHCEA.

#### XANTHOPHCEA ORNATA, n.sp.

Elongate; head stout, lightly constricted behind eyes, neck wide; prothorax of equal length and breadth, wider across base

(2 mm.), than apex (1.7 mm.), lightly rounded on sides, lightly sinuate before base, basal angles subrectangular; elytra punctate-striate, third interstice unipunctate about apical sixth. Pale testaceous; head, pronotum, tarsi, antennæ and palpi darker than elytra; undersurface, legs and head on each side behind eyes infuscate; pronotum with a black vitta extending from apex to base on each side of disc; elytra with three black vittæ, a sutural one extending from scutellum to apex on two inner interstices of each elytron, and a lateral one on each elytron extending from humeral angle to near apex on seventh interstice, a transverse row of four black spots between apices of each lateral vitta and the sutural vitta; abdomen with narrow infuscate margin, apical ventral segment piceous-black; apex of body infuscate, projecting beyond elytra.

Head large (2.15 mm. across eyes), convex, lightly and obliquely narrowed behind eyes to the broad neck; vertex minutely punctate under a lens; front biimpressed on each side between base of antenna and eye; eyes convex, prominent; postocular part of orbits small, not protuberant, rising gently from neck. Prothorax decidedly wider than head (2.5 × 2.5 mm.), lightly convex on disc, widely margined laterally, lævigata on disc, punctate towards apex and base, and on sides outside the black vittæ; apex truncate; anterior angles obtuse, near neck; base with median part shortly but decidedly produced backwards; basal angles rectangular, with summit obtuse; anterior marginal seta at widest part a little before middle, not on border; median line deeply impressed. Elytra subparallel (7 × 4 mm.), widest a little behind middle; sides very lightly sinuate about anterior fourth; humeral angles rounded; interstices nitid, hardly convex, a row of minute punctures along middle of every one, first with a punctate stria at base. Metasternum with a few fine setigerous punctures near sides (only perceptible under a lens). Ventral segments glabrous, bisetigerous, apical segment 2-punctate on each side in ♀. Length 11-13, breadth 4 mm.

*Hab.*—N.S.W.: Berowra (Messrs. Carter and Ferguson). Colls. Carter, Ferguson and Sloane.

A very distinct species, the handsomest of the genus. It requires comparison only with *X. grandis* Chand., from which some conspicuous differences are—head convex, not strongly constricted behind eyes; bivittate prothorax; less punctate elytral interstices, etc.

*XANTHOPHŒA NIGRICINCTA*, n.sp.

Elongate, convex; head—with eyes—wider than prothorax, obliquely narrowed behind eyes; prothorax cordate, convex, narrowly margined; elytra convex, punctate-striate; interstices depressed, third unipunctate about posterior fifth. Ferruginous (elytra a little paler than prothorax and head); prothorax narrowly margined with black on sides; each elytron margined with black (except base of interstices 2-6), this black margin narrow along suture (occupying first interstice), apex and apical part of sides, wider from shoulders backward to apical fourth (occupying three external interstices).

Head 1.25 mm. across eyes, nitid, impunctate, convex, rather strongly obliquely narrowed behind eyes, transversely impressed behind orbits; front lightly impressed on each side behind clypeus; eyes convex, prominent; postocular part of orbits rising obliquely from neck. Prothorax hardly longer than broad (1.15 × 1.2 mm.), widest before middle, convex; disc nitid, impunctate; apex truncate; anterior angles near head, lightly indicated; sides rounded on anterior three-fourths, sinuate posteriorly; base truncate, basal angles marked, obtuse at summit; anterior marginal puncture on border at widest part; marginal channel wide (but not explanate), deep and foveiform at basal angles; border narrow, reflexed; median line deeply impressed. Elytra greatly wider than prothorax (4 × 2 mm.), convex, parallel; humeral angles rounded; interstices nitid, a row of minute punctures perceptible along middle of every one under a strong lens; first and second striae not reaching basal puncture (this distinct, isolated); striae

at base of first interstice not strongly developed. Length 6·5-8, breadth 2·2-5 mm.

*Hab.*—N. S. Wales: Tweed River (Froggatt); Brunswick River (Carter). Coll. Sloane.

A very distinct species, easily distinguished by the pattern of its elytra, convex form, cordate narrowly margined prothorax, etc. I owe my specimens to the kindness of Messrs. Froggatt and Carter.

#### Genus MICROLESTES.

##### MICROLESTES ATRIFASCIATUS, n.sp.

Oval, depressed. Head and prothorax piceous-black; elytra pale testaceous, with a transverse vitta just behind middle, and two small subapical maculae outside third interstice, black; legs pale testaceous, with apex of tibiae and tarsi a little infuscate; antennae and palpi testaceous.

Head finely shagreened. Prothorax wider than head, transverse ( $0·6 \times 1$  mm.), subconvex, finely shagreened; anterior margin lightly and widely emarginate, not bordered in middle; sides very lightly narrowed to base, not sinuate posteriorly; lateral border reflexed, wide at the obtuse basal angles, entire on base—wide on lateral parts, very fine on basal lobe. Elytra oval ( $3 \times 1·5$  mm.), not attaining apex of abdomen, finely shagreened; five inner striae finely but distinctly impressed, others obsolete, first striae lightly out-turned near base and (with second stria) rising from a basal puncture, third and fourth striae uniting near posterior margin of the black fascia; third interstice with a fine setigerous puncture just behind the black fascia, and another at apex. Ungues serrate. Length 3·6, breadth 1·5 mm.

*Hab.*—Q.: Kuranda (Dodd). Coll. Sloane.

This species is at once differentiated from all the other Australian species by the pattern of the elytra. The black fascia has its posterior margin sloping obliquely backwards towards the suture, with the outline broken; the anterior margin is less oblique, consequently the fascia is widest at the middle.

Four Australian species of *Microlestes* have been described, which may be tabulated as under (*M. humeralis*, *M. yarrae*, and *M. australiensis* were described as species of *Dromius*):—

**A. Species with bicolorous elytra.**

B. Elytra infusate, with base widely (also a sutural spot near apex) testaceous ..... *M. humeralis* Macf.

BB. Elytra testaceous, with a narrow black fascia behind middle.....*M. atrifasciatus* Sl.

[illegible]

**Subfamily PSEUDOMORPHINÆ.**

Genus **ADELOTOPUS.**

**ADELOTOPUS INSIGNIS, n.sp.**

Elongate-oval, parallel, convex. Piceous-black, shining; under surface piceous. Head large (2 mm. across eyes), sparsely but distinctly punctate. Prothorax large, parallel on sides, broader than long (2.2 x 2.5 mm.), sparsely minutely punctate; anterior margin truncate; anterior angles marked, subrectangular; inner angle formed by junction of lateral and anterior margins sharply marked; base lightly emarginate above peduncle; basal angles not marked, very widely rounded; lateral margin not explanate; lateral channel narrow; border wide and reflexed on sides, entire and very narrow on apex and base. Elytra parallel, not wider than prothorax (4 x 2.5 mm.), not covering apex of body, seriate-punctate (nine rows of punctures on each elytron); inflexed margins with a row of setigerous punctures (setae near shoulders duplicated and visible from above). Exposed apex of body strongly punctate. Antennae much longer and more slender than usual in *Adelotopus*, extending to middle of anterior coxal cavities; basal joint much larger and more inflated than usual in the genus. Labial palpi very widely securiform. Prosternum not carinate, punctate before coxae; intercoxal part depressed, shortly truncate posteriorly. Length 7, breadth 2.5 mm.

*Hab.*—Victoria: Sea Lake, Mallee District (Goudie). Coll. Sloane.

This remarkable species represents a separate section of the genus *Adelotopus*. The setigerous puncture on each side of the clypeus is placed on the upper surface, not under the anterior margin of the head, as in other species; and there is on each side of the front, at a considerable distance from the middle of the inner margin of the eye, a setigerous puncture, more conspicuous than the other scattered punctures of the head. This is the only case of an *Adelotopus* with intraorbital setæ, known to me. The pronotum bears minute scattered punctures on its surface, and is without the more or less explanate lateral margins found in other species of the genus. The punctures of the elytral series are, separately impressed in the derm at a little distance from one another in the rows; the narrow marginal border, not hiding the inflexed margins near the shoulders and traceable to the sutural angle, is a character found in no other species. Mr. J. C. Goudie found one specimen, which he generously presented to me.

## THE ENTOMOLOGICAL FAUNA OF NAURU ISLAND, OF THE OCEAN ISLAND GROUP.

By WALTER W. FROGGATT, F.L.S.

Nauru is an isolated island almost on the equator, lying about 150 miles north-west of Ocean Island. It was known as Pleasant Island before it was included in the group of different islands comprising the German zone, when the name was changed to Nauru; while in some of the charts it is called Nawada Island. It is much larger than Ocean Island, measuring thirteen miles in circumference, but has no great elevation above the sea. It has a small native population, and a fair growth of vegetation, comprising some coconut groves, with mangroves, and pandanus on the water's edge. The vegetation in general is low and scrubby, with scattered "mangoni" trees growing on the better land; the open country is well grassed. Both Ocean and Nauru Islands contain very rich deposits of phosphates, so that there is a comparatively large population at work upon them at the present time.

The insects herein noted, were obtained by Mr. F. W. Steel, and are chiefly intrusive, having been introduced with timber and produce, though several are cosmopolitan in their range. Mr. Steel informs me, however, that the material furnished does not represent the whole of the insect-fauna, as there are many dragonflies to be found round a lagoon or lake occupying the centre of the island; and that mosquitoes are very troublesome at times. Butterflies were rare, though he noticed a good many different species of moths. Among the specimens received were three diptera; but these have not yet been identified.



## ORTHOPTERA.

## Family FORFICULIDÆ.

*CHELISOCHES MORIO* Fabr.

This earwig is common to many of the Pacific islands. It is slender, shining, and black, measuring up to an inch in length, with the antennæ and apical segments of the abdomen shaded with reddish-brown; the forceps long, slender, and toothed in the male.

Kirby\* gives the range Otaheite, India to New Guinea. Dr. Burr, to whom I am indebted for the identification, says—"This species is exceedingly abundant and widely distributed throughout the Oriental regions." It is very common in the Pacific Islands, abundant in the Sandwich Islands; and is spreading artificially, as I have specimens from East Africa; and it has been taken in Kew Gardens. During my recent visit to the Solomon Islands I found it very plentiful upon the trunks of the young coconut palms, sheltering under the bases of the leaf-stalks.

*ANISOLABRIS ANNULIPES* Luc.

This is another cosmopolitan species, ranging from Europe, across India, to the Islands of the Pacific. The specimens were immature, but Dr. Burr says they belong to this species.

## Family BLATTIDÆ.

*PERIPLANETA AUSTRALASIE* Fabr.

This cosmopolitan species was described from Australia in 1775; it is comparatively rare in this country, but is the common domestic cockroach of Florida, and other of the Southern States. It has a wide range over the Pacific Islands.

*PYRROSCELUS SURINAMENSIS* Linn.

Originally described from Surinam, it has since been redescribed under half a dozen other specific names. Mr. Shelford says of

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\* Brit. Mus. Cat. Orthoptera, i., p. 33.

it—"A cosmopolitan, slightly variable species." I have received it, in company with the last, from several of the Pacific Islands, the Carolinas, and Tonga.

## COLEOPTERA.

### Family HYDROPHILIDÆ.

#### DACTYLOSTERNUM ABDOMINALE Fabr.

This beetle has a very wide range through the Australian and Oriental regions, and is common on the Mediterranean. Mr. J. J. Walker says—"I have taken it at Gibraltar. It is probably disseminated by commerce, as it lives in rubbish and decaying vegetable matter; and I should not be surprised if it turned up some day in England." It is a small, shining, black beetle, with reddish-brown antennæ and palpi; and the elytra marked with fine, parallel, punctate striæ. Length about  $\frac{1}{2}$  inch.

#### XYLOPERTHA sp.

This handsome little Bostrychid beetle was submitted, with others, for identification, to Mr. J. J. Walker, who furnished the following note—"This is a common Australian Bostrychid, near the genus *Xylopertha*, if not actually belonging to it." He could not determine the species, however. Mr. A. M. Lea, of Hobart, who also examined it, said it was unknown to him.

Head and thorax black, with the front of the latter covered with fine rugose points on either side, and finely punctured in the centre, the rest of the upper surface finely rugose. Legs and elytra reddish-brown, the latter very finely and closely punctured, furnished with a fine flange round the outer margin. Length  $\frac{1}{2}$  inch.

#### TROGOSITA (TENEROIDES) MAURITANICA Linn.

There are a number of specimens of the world-wide flour-beetle from Nauru. This curious, flattened, shining, black beetle has been redescribed under a number of different names; and has been spread all over the civilised world, with flour and grain, the

latter being the favourite food of the larva. It is known as the "Cadelle" in France. Both the beetle and its curious larva were figured by me in the Agricultural Gazette of N. S. Wales (October, 1898) from specimens obtained in wheat in Sydney.

#### OTIORRHYNCHUS sp.

The genus to which this weevil belongs, is a very large one, containing a great number of different species. Mr. J. J. Walker examined the collections in the Hope Museum, at Oxford, without finding anything like it. He then sent it to Mr. Gahan, of the British Museum, and afterwards wrote.— "Neither Mr. Gahan nor I could find anything, even generically near it, in the large series of these found at the Museum; and it is probably something quite new. I do not remember anything like it in the Australian beetle-fauna." Mr. Lea says, "This is close to several European species of *Otiorrhynchus* in my collection, but I have nothing exactly like it."

It measures  $\frac{1}{2}$  inch in length, and is of a general shining greyish-brown tint, with reddish legs and antennæ; clothed with fine white pubescence. The head from above the eyes to the jaws is finely punctured; thorax finely but irregularly punctured; elytra marked with fine, parallel striæ, with the edge of the elytra produced into fine serrate spines along the outer edge, but absent at the extreme tip.

#### HYMENOPTERA.

##### Fam. FORMICIDÆ.

Only one species, a very small red ant, was obtained; about twenty examples were received, without any information about its habits. Specimens were sent to Dr. A. Forel, who has described it as a new species, *Prenolepis*(*Nylanderia*) *Stesli* Forel, "Formicides. Australiens reçus de MM. Froggatt et Rowland Turner." *Revue Suisse Zool.*: Ann. Soc. Zool. Suisse et du Mus. d'Hist. Nat. de Genève. Tome xviii., fasc.1, p.69, 1910.

A NEW SPECIES OF *LEPIDOSPERMA* [N.O. CYPERACEÆ] FROM THE PORT JACKSON DISTRICT;  
WITH SOME MISCELLANEOUS BOTANICAL  
NOTES.

By A. A. HAMILTON.

*LEPIDOSPERMA FORSYTHII*, n.sp.

Centennial Park, in swamps; flowers in April; fruit in August, 1902 (A. A. Hamilton).

A tufted spreading herb with a short rhizome. Stems 3 to 5 ft. long, comparatively slender, obtusely angular, finely striate, occasionally grooved. Leaves reduced to long, loose, broad, scarious sheaths with a lamina scarcely  $\frac{1}{2}$  in. long (short for the genus). Panicle about  $1\frac{1}{2}$  in. long, spreading, much branched, the rhachis very flexuose as in *L. flexuosum* R.Br. Sheathing bract of the panicle about 1 in. long. Bracts of the panicle-branches and spikelets gradually shorter, all obtuse but with a short lamina. Glumes obtuse, the midrib produced into a conspicuous point. Spikelets 4 to 5 lines long. The young inflorescence pale brown, growing darker with age. Barren and fertile flowers as in the genus. Nuts obovoid, with three flattened ribs, broadly contracted at the base, finely reticulate, not shining, reddish when young, the colour gradually fading as the fruit matures. Scales irregular, frequently all on one side of the nut, longer, narrower, and more lax than in *L. flexuosum*.

Planta caespitulosâ, diffusâ, herbifera; rhizoma brevi. Calami 1-1.5 m. alti, comparative graciles, obtuse angulati, tenuissime striati, nonnunquam canaliculati. Folia attenuata ad longas latas laxas scariosas vaginas, lamina circiter 1.3 c.m. longa. Panicula circiter 3.8 c.m. longa, diffusâ, ramosissima, ax'e tam flexuosa quam in *L. flexuosa* R.Br. Bractea amplexans paniculae circiter 2.5 c.m. longa. Bractea ramorum, panicularum spiculorumque gradatim breviores, omnes obtusae at lamina brevi.

Glumæ obtusæ, costa elongata ad manifestum apicem. Spicula 8-9 mm. longa. Inflorescentia immatura fusca-pallida, maturitate atrior. Flores steriles fertilesque tamquam in genere. Nuces obovoideæ, costis tribus, complanatis, basi attenuatæ, delicatissime reticulatæ, non nitidæ, immaturitate rubentes, maturitate gradatim decolorantes. Squamæ incompositæ, sæpe omnes in unum, longiores, angustiores, laxiores quam in *L. flexuoso* R.Br.

Allied to *L. flexuosum* R.Br., and *L. carphoides* F.v.M. The former differs in having the stems terete, not grooved; leaf-sheaths closely appressed, with a long lamina; points of the bracts of the panicle-branches, spikelets, and glumes inconspicuous; nuts oblong, smooth, shining, brown-mottled; scales short, broad, appressed; the whole plant smaller and less robust.

*L. carphoides* differs in the appressed leaf-sheath with long lamina; fruit obtusely angular, strongly reticulate; scales almost regular, standing out from the attenuate base of the nut; panicle spike-like, the branches not flexuose.

This plant was first discovered in a swamp in the Centennial Park, in March, 1897, by Mr. W. Forsyth, a Member of this Society, who forwarded specimens to the National Herbarium. On examining the material, it was found that there were no mature fruits (which furnish an important character in the genus). A provisional description was prepared, and laid aside with the specimens, awaiting more advanced nuts. Later, the writer collected fruiting specimens in the same locality. While working recently on Cyperaceous plants, particularly *Lepidosperma*, I prepared some notes on this species which were forwarded, with complete botanical material, to Mr. Maiden, who later on returned them, accompanied by the "Herbarium Notes," which he generously placed at my disposal. The plant appears to be confined to the above locality. The name is proposed in compliment to the discoverer. The type-specimens will be presented to the National Herbarium.

#### TRICOSTULARIA PAUCIFLORA Benth.

Leura (A. A. Hamilton; November, 1909). New for New South Wales.

Some difficulty was met with in the determination of this plant, owing to an inadvertent reference of the species to *Lepidosperma filiforme* Labill., by Sir J. D. Hooker, in his "Flora of Tasmania" (Vol. ii., 93). See note on *Tricostularia pauciflora* Benth., Fl. Austr., vii. 383. This reference has evidently been followed by Mr. Archer in the placing of Tasmanian specimens of *T. pauciflora* Benth., (now in the National Herbarium, Sydney) under *Lepidosperma filiforme* Labill.

References.—*Chapelliera pauciflora* Nees, fid. Mueller, Hooker's Fl. Tasm. ii., 93; *Schœnus pauciflorus* F.v.M., Syst. Census of Austr. Plants, p. 128, 1882; *Chapelliera pauciflora* Nees; *Tricostularia pauciflora* Benth., = *Lepidosperma pauciflorum* F.v.M., Index Kewensis.

*Hab.*—"Victoria: near Mt. Abrupt, F. Mueller; near Mt. William, Sullivan" [Fl. Austr. p. 383]. Mr. W. Forsyth has collected specimens of this plant at La Perouse (November, 1899); and we have, in the National Herbarium, specimens from Sutherland, (November 14th, 1900) and French's Forest (September, 1908), collected by Mr. J. L. Boorman.

Note on *Cyperaceæ*.—In determining Cyperaceous plants, the characters, colour of the fruits, and height of the plants, are occasionally used to distinguish a species, or separate a genus into groups. Of the former character it is noticed, that the fruits of several species are coated, when young, with a "pale" membranous testa, which persists for a lengthy period, finally withering, and exposing the "dark" nuts. In reference to the latter, we find plants placed under a group 1 to 3 in. high, attaining a height of 6 to 9 in., which would qualify them for inclusion in a different group.

Three Cyperaceous plants from the Blue Mountains hitherto regarded as coastal—

#### *SCHœNUS MOOREI* Benth.

Mount Wilson (J. Gregson; November, 1901); Wentworth Falls (J. H. Maiden; September, 1898); Leura (A. A. Hamilton; November, 1909).

## LEPIDOSPERMA TENUISSIMA, F.v.M.

Leura(A. A. Hamilton; November, 1909).

## HELEOCHARIS MULTICAULIS Sm.

Katoomba(A. A. Hamilton; March, 1910.)

*Miscellaneous notes, new records, &c.*

## PERSOONIA CHAMÆPEUCE Lhotsky.

Near Narrabeen(A. A. Hamilton; June, 1908). Not recorded in Dr. Woolls' "Plants indigenous in the Neighbourhood of Sydney."

## ACACIA ASPARAGOIDES Cunn.

Medlow(A. A. Hamilton); flowers in October; fruit in December, 1907. Only one locality is given for this plant in the Fl. Austr., "Rare on the rocky verge of Regent's Glen, Blue Mountains." . . . "Pod unknown." It is plentiful on both sides of the Bathurst Road, from Medlow to Blackheath; and we have specimens, in the National Herbarium, from Clarence Siding(J. H. Maiden; September, 1898); and Mount Wilson(J. Gregson; September, 1901). The pod is more or less constricted between the seeds, about 1 line broad. Seeds longitudinal, the funicle slightly folded and filiform, as in *A. juniperina* Willd.

## PULTENZEA GLABRA Benth.

Leura Falls(A. A. Hamilton; December, 1907). Recorded from the Blue Mountains without specific locality. It is common, in swamps, from Hazelbrook to Katoomba.

## GNAPHALIUM JAPONICUM Thunb., var. RADICANS F.v.M., MS.

Leura(A. A. Hamilton; November, 1909). Previously recorded from the Munyong Mountains, Vic., F.v. Mueller; and Mt. Kosciuszko, tree-line to 7000 ft.(J. H. Maiden and W. Forsyth; January, 1899). See these Proceedings, 1899, p.148.

CHENOPODIUM NITRARIACEUM, F.v.M. }  
ATRIPLEX LEPTOCARPUM, F.v.M. }

George's River(A. A. Hamilton; November, 1909). Two Salsolaceous plants, known as interior species, which have found their way to the coast probably through the agency of travelling stock.

ASTROLOMA HUMIFUSUM R.Br.

Mt. Victoria(A. A. Hamilton; April, 1908). This species has not been recorded from the Blue Mountains.

PANICUM GRACILE R.Br.

Stanwell Park(A. A. Hamilton; June, 1909). A degraded form of *P. gracile* R. Br., with the panicle-branches reduced to a single spikelet, the rhachis produced into a point longer than the spikelet.

CYPERUS TRINERVIS, R.Br.

Carlingford(A. A. Hamilton; April, 1909, and Fairfield, May, 1909). Not mentioned in Dr. Woolls' "Plants indigenous in the Neighbourhood of Sydney."



### Discussion.

*Subject*—The application of "Jordan's Law" to the case of the Australian fauna and flora.

The generalisation, to which Dr. J. A. Allen has applied the name of Jordan's Law, has been stated thus—"Given any species, in any region, the nearest related species is not to be found in the same region nor in a remote region, but in a neighbouring district separated from the first by a barrier of some sort or at least by a belt of country, the breadth of which gives the effect of a barrier."

President D. S. Jordan has given an exposition of his views, in a paper entitled "The Law of Geminate Species" (*American Naturalist*, Vol. xlii., p.73, February, 1908). Geminate species are defined as "twin species—each one representing the other on opposite sides of some form of barrier. In a general way, these geminate species agree with each other in all the respects which usually distinguish species within the same genus. They differ in minor regards, characters which we may safely suppose to be of later origin than the ordinary specific characters in their group"(p.75). . . . "One of the most remarkable cases of geminate species is that of the fishes on the two sides of the isthmus of Panama. Living under essentially the same conditions, but separated since the end of the Miocene Period by the rise of the isthmus, we find species after species which has thus been split into two"(pp.75-76). . . . "Among plants we often notice the fact—rare though not unknown among animals—of numerous species of the same genus occupying the same area. In some cases these species are closely related, suggesting mutants, and in other cases the relation indicates the existence of hybrids. . . . Eucalyptus, Acacia, and Epacris in Australia are examples even more striking. But I have never seen very closely related or geminate forms in any of these genera actually growing together. I suspect that they do so sometimes and that the explanation is found in reinvasion"(pp.78-79).

MR. FLETCHER—Before considering the case of the Australian Batrachia, the obvious, important, natural barriers which have been mainly instrumental in bringing about the existing distribution and segregation of species, may be pointed out—the Great Dividing Range, Torres Straits, Bass Straits, and the climatic barrier due to the aridity of dessicated Central Australia. The first of these is the oldest; but in places, at any rate, it is not an absolute barrier to some species; and it runs out altogether to the south-west. The others are believed to be not older than Post-Pliocene. The second, Torres Straits, must be left out of account because of the lack of knowledge enabling one to compare the Batrachian faunas of North-East Australia and New Guinea. The contiguous faunulae into which the barriers indicated have subdivided the Batrachian fauna, are not specially remarkable for the number of geminate species which they offer. They may be described, in general terms, as comprising representatives of widely spread species which had already attained a very wide distribution before the barriers indicated (the Dividing Range, perhaps, excepted) had become effective, or of slightly modified forms—colour-varieties, geographical races or subspecies, not entitled to receive special names; together with a few species (like the Tasmanian and Victorian species of *Crinia*, for example) which are perhaps entitled to be considered geminate forms: or of such an assemblage, together with local species, and representatives of restricted or even monotypic genera. For instance, a Tasmanian collection of frogs might be successfully passed off upon an unsuspecting biologist as a South Victorian collection. The frogs of King Island, in Bass Straits, as far as known, are to be found in both Tasmania and South Victoria; and the freshwater fishes in one or the other, or in both (Johnston). On the other hand, allied forms certainly do occur in the same area, without any discernible physical barrier operating, so far as one can judge—e.g., *Hyla ewingii* var. *calliscalis* and *H. krafftii*; *Limnodynastes tasmaniensis* and *L. fletcheri* Blgr.; *Pseudophryne australis* and *P. bibronii*. In such cases, physiological isolation probably functions as a barrier. As far as the Australian Batrachia

are concerned, a reasonable conclusion seems to be that the existing physical barriers are not sufficiently old, geologically speaking, in most cases nothing like so old as Miocene; or not absolutely impassable and effective; or, when climatic, liable to intermittent or partial break-downs; and that, for these or other reasons, Jordan's Law is not strikingly applicable.

MR. FROGGATT exhibited specimens representing six species, referable to three genera, of the Family *Cicadidæ*; which, he considered, might fairly be called three pairs of geminate species. (1) *Thopha saccata* Fabr., is confined to the south and east coasts of Australia, from South Australia to Brisbane; it is the largest species common about Sydney; the country about Gosford and Newcastle is one of its favourite localities. *T. sessiliba* Dist., was described from Townsville, Q.; it ranges from the Northern Territory to Townsville; recorded also from Tennant's Creek, N.T., and Goonowindi at the head of the Barwon River, on the Queensland border. The break between the areas over which these two species are distributed is well marked; though Goonowindi is about in line with the northern limit of *T. saccata*, there is a good barrier offered by a mountain range. (2) *Cystosoma saundersi* Westwood, was formerly common at Ash Island, Hunter River; it is not found south of Sydney, Gosford being its southern limit; recorded also from Armidale, Glen Innes, and the Bellenger River; but not known from any locality north of the Richmond River. *C. schmeltzi* was described by Distant, from Gayndah, Q.; it occurs also in the neighbourhood of Townsville, Q. The southern species was common in Citrus orchards in 1860; it is found on sweetbriar at Armidale, and at Glen Innes upon the willows; this points to the fact that its native scrub food has been destroyed. The barrier between the two species is due to the character of the country, with a scarcity of scrub on the coast to the south of Townsville. (3) *Tettigarcta tomentosa* White, from Launceston, Tasmania, living in fern-tree gullies, according to Mr. Simson; it has been erroneously recorded from Victoria; but is not found on the mainland, though Distant incorrectly gives the habitat as Australia in his Catalogue(1906).

*T. crinita* Distant, described from Australia, without exact locality; Gippsland, Melbourne, and Kunell East, are the only known localities for it—a wide range along the southern portion of Southern Victoria; Kershaw says it is found, like the Tasmanian species, in fern-tree gullies.

MR. TILLYARD—Australian dragonflies (ODONATA) seem to offer a very good test-case, for several reasons. (1) The group is a small one, so that careful records of localities, sufficient to indicate the range of distribution of species, can be made and analysed with great exactitude. (2) There is very little variation in the species of the group. (3) Hybridisation between closely allied species is impossible, owing to the remarkable divergence in formation between the genital appendages of both sexes in closely allied species. A male of one species cannot pair with a female of another closely allied species. In many cases the two species may be almost exactly alike in colouring and may occur together on the same river or lagoon, yet crossing cannot possibly take place. This is a most important point, as it simplifies matters very greatly.

An analysis of the 170 species comprising the Australian Odonate fauna gives the following results:—(1) Nearly 50 species belong to monotypic genera; these are of no value in this discussion. (2) Between fifty and sixty have their distribution too imperfectly known to be of any real value. (3) Out of 65 remaining species, belonging to 18 genera, all possible pairs which are clearly very closely allied\* have been chosen. A few pairs, not really closely related, but still placed in the same genus in the present classification, have also been omitted. The total is forty-three pairs. Of these only eight are geminate, in the sense of being closely allied species separated by a definite barrier. They are as follows:—

\* It is necessary to bear in mind the operation of the "personal equation" in this choice. By including the few pairs which have been rejected as being, in the speaker's opinion, not sufficiently closely allied, the number of geminate species is not only not increased, but their proportion to the whole is diminished.

## (A)—BARRIER, BASS STRAITS.\*

- { *Synthemis eustalacta* Burm.(S.A., Vic., N. S.W.).  
 {     "     *tasmanica* Tillyard(Tas.).

## (B)—BARRIER, DESERT-BELT BETWEEN E. AND W. AUSTRALIA.

- { *Nannodythemis dalei* Tillyard(East Australia and Tas.).  
 {     "     *occidentalis* Tillyard(W.A.).  
 { *Procordulia jacksoniensis* Ramb.(Vic. and Tas.).  
 {     "     *affinis* Selys(W.A.).  
 { *Austrogomphus australis* Selys(S.A.).  
 {     "     *collaris* Selys(W.A.).  
 { *Austroaeschna parvistigma* Selys(East Australia and Tas.).  
 {     "     *anacantha* Tillyard(W.A.).  
 { *Argiolestes grisea* Selys(Vic. and N. S.W.).  
 {     "     *minima* Tillyard(W.A.).  
 { *Pseudagrion cyane* Selys(East Australia and Tas.).  
 {     "     *cæruleum* Tillyard(W.A.).

## (C)—BARRIER, SOUTHERN PACIFIC.

- { *Phyllopetalia patricia* Tillyard, N. S.W.  
 { [*Phyllopetalia* and allied subgenera, Chili].†

Of these eight pairs, no less than six indicate the desert-belt between Eastern and Western Australia as the determining barrier. It is interesting, therefore, to enquire what proportion of the total Odonate fauna is represented by "geminate" pairs. There are 27 species so far recorded from Western Australia. Of these, one has no close allies; two others belong to a distinct Australian genus, but are not closely allied to any of the Eastern species of that genus; *no less than eighteen* occur on both sides of the barrier without the slightest modification. The proportion of geminate species, then, in the West Australian *Odonata* is only two-ninths, or 22 %. About the same number of species occur in the area lying east of the barrier, including the southern

\* See also Hedley, on the "Bassian Isthmus," Proc. Linn. Soc. N. S. Wales, xxviii., 1903, p.876.

† An interesting barrier, Torres Straits, separating Australia from New Guinea, is not here discussed, owing to lack of data.

parts of South Australia, Victoria, and Tasmania, so that the proportion is about the same for this side of the barrier also.

In the case of Bass Straits, of the twenty-four species found in Tasmania, twenty-three occur also in Southern Victoria. It is curious, however, to notice that several common South Victorian species, including the large strong-flying *Hemianax papuensis*, have not succeeded in establishing themselves in Tasmania.

In the case of New South Wales and Chili, there are, as might be expected, no species common to both; and only one pair of closely allied species.

When the 43 closely allied pairs chosen are classified, it is found that they fall easily into three main groups, which may be termed respectively Inlying Pairs, Overlapping Pairs, and Isolated Pairs\*:

(1) *Inlying Pairs*.—Those in which the distribution of one species is a small region entirely surrounded by a larger region, over which the commoner and more widely distributed second species ranges. There are ten cases of this out of the 43.

(2) *Overlapping Pairs*.—Those in which the distribution of one species coincides with that of the other for a greater or less portion of the total area. There are 24 cases of this.

(3) *Isolated Pairs*.—Those in which the two regions of distribution are quite distinct. There are nine cases of this, viz., the eight "geminate" pairs, and the isolated *Lestes aridus* Tillyard, which has been paired with *L. analis* Ramb., a species that surrounds it on all sides but does not reach the same region.

Assuming that, in the case of the *Odonata*, geographical isolation has played a distinct part in the formation of new species; and, admitting also, the strong probability of "mutation" or the sudden arising of new forms, a simple explanation can be offered not only for the occurrence of these three forms, but for their relative frequency:—

(A) In fig. 1 of Plate x., let the large, lightly-shaded area represent the region of distribution of a species, X. Suppose a muta-

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\* Three exceedingly apt terms suggested by Mr. A. H. S. Lucas.

tion  $X^1$  to arise suddenly at an internal point  $a$ (fig.1), and to propagate itself in the vicinity of  $a$ (fig.2). This may finally establish itself as a definite species  $X^1$  in a smaller region (dark area in fig.3), completely surrounded by the region of the original species. This would be an example of an *Inlying Pair*.

(B). Let the large lightly-shaded area, represent, as before, the region of a species,  $X$ . Suppose a mutation  $X^1$ , to arise suddenly at a point  $b$ (fig.4), near the border of the region; and to propagate itself, partly within, and partly without that region (fig.5). This may finally establish itself as a definite species,  $X^1$ , in a smaller region partly overlapping the other region(fig.6). This would be an example of an *Overlapping Pair*.

(C). Taking the large area, as before, for the region of  $X$ , let a geological change raise a barrier across the region at  $ab$  (fig.7). Let this gradually increase the isolation of one portion of  $X$  from the other(fig.8). The two portions of  $X$  may be expected finally to evolve in slightly different directions, yielding two closely allied species,  $X_1$  and  $X_2$ , separated by a definite barrier(fig.9). This would be an example of an *Isolated Pair*.

(D). If, at a later period of time, the geographical barrier raised in C be removed, the two species  $X_1$  and  $X_2$  may extend their bounds, and remain as a distinct *Overlapping Pair*, provided they are sufficiently differentiated to preserve their particular characters\*(fig.10).

Assuming that, in taking a very large number of cases, all four possibilities are equally likely, a result may be expected, approximating to :—

Inlying Pairs(Case A) .....	25%
Overlapping Pairs(Cases B and D).....	50%
Isolated Pairs(Case C) .....	25%

\* Mr. C. Hedley has suggested the term "area of cohabitation" for the region common to both species in this case. The same term would apply to the similar region in case B.

The analysis of the 43 pairs of Odonata chosen, yields a result remarkably close to this expectation, viz :—

Inlying Pairs(10 out of 43).....	23%
Overlapping Pairs(24 out of 43) .....	56%
Isolated Pairs(9 out of 43) .....	21%

It is not proposed to claim the dignity of a natural law for these suggestions, as it is obvious how very far from the truth they might be in the case of a complicated group, such as the Australian Eucalypts; where, even if the numerous species could be defined satisfactorily, and the main causes that gave rise to them were known, many other forces besides those here taken into account, must have operated in forming them. The evidence of the Australian dragonflies, therefore, is on the whole distinctly adverse to the acceptance of "Jordan's Law," as holding generally between allied species. In Australia, at any rate, the barriers have been neither strong enough nor lasting enough to have affected the majority of native forms.

ACTING-PROFESSOR S. J. JOHNSTON—In formulating his law, Jordan seems to have supposed that one of the essential factors in the evolution of his geminate species from their ancestral types, is *Geographical Isolation*. While this may be mainly true in the case of the higher animals, in the case of lower animals and of plants *physiological selection* is a much more potent factor and may quite exclude geographical isolation; so that we find two closely related species, so closely related that they may be looked upon as having diverged from a common ancestral type, living side by side and not separated by a geographical barrier, as Jordan states. As we descend in the scale of animal life Jordan's Law seems to be less and less applicable, while to plants it does not seem to apply at all. In plants, for instance, physiological selection, working through such factors as *prepotency*, *differences in the time of ripening of flowers*, *small differences in structure adapted to special insects*, seem to be much more potent in producing that divergence in structure which leads to the formation of new species than geographical isolation.



In looking over closely related pairs of Australian species of plants, we find them growing not in closely adjacent districts which are separated by some geographical barrier, but actually growing side by side as we should expect when some form of physiological isolation has been the chief factor in separating them. For instance: *Todea barbara* and *T. fraseri*; *Darwinia fascicularis* and *D. taxifolia*; *Dillwynia ericifolia* and *D. floribunda*; *Angophora lanceolata* and *A. intermedia*; *Epacris pulchella* and *E. purpurascens*—pairs of very closely related species, more closely related to one another, apparently, than any others of the same genus are found, not isolated but growing side by side. Corresponding pairs of species of animals to which similar remarks are applicable are—*Macropus giganteus* and *M. robustus*; *Python spilotes* and *P. variegata*; *Amphibolurus barbatus* and *A. muricatus*; *Tiliqua scincoides* and *T. nigrolutea*; and many other such pairs, both of plants and animals, could be readily mentioned.

DR. CHAPMAN offered some theoretical considerations.

MR. MAIDEN instanced the genus *Phærospæra* [N.O. CONIFERÆ] a very local genus, one of whose species has a very limited range on certain mountains in Tasmania, and the other on the Blue Mountains of N.S.W. *Dodonæa filifolia* of Queensland and New South Wales, and *D. ericifolia* of Tasmania, probably had a common ancestor which grew along the greater part of the entire eastern coast of Australia. The genus *Eucalyptus*, which includes many species, offers some which may fairly be looked upon as geminate. The *E. stellulata-Moorei*, *E. amygdalina-regnans*, *E. amygdalina-dives* pairs all grow together, without obvious barriers. The *E. Cambagei-goniocalyx*, *E. polyanthemus-Rudderi* pairs have localities which join on to one another, or are separated by not a wide barrier. The *E. tereticornis-Sesania* pairs grow together, but the *E. tereticornis-rostrata* pair is separated by the dry barrier of the Eastern Plains, though they touch, where the climatic conditions approximate, in the Yass-Bowring district. Speaking broadly, the law seems to be only of imperfect application to Australian plants.

MR. R. H. CAMBAGE—The physical features of New South Wales provide excellent conditions for testing Jordan's Law in regard to plants, inasmuch as the high mountain-range so divides the climatic conditions that, on the eastern side, the climate is moist and warm, while on the west the atmosphere is dry. Taking some of the Box-trees belonging to the genus *Eucalyptus*, results are found somewhat in support of Jordan's Law, but for the most part the examples rather fail to harmonise with it; and it is thought that, although the law may hold for some species which originated prior to the formation of a particular barrier, there are other causes which produce the same results. On the eastern face of the mountain-barrier, *E. hemiphloia* is common, while on the western slope *E. albens* is plentiful. These are closely allied species, and there is some uncertainty whether one is not a variety of the other. Where the mountain is low in the Liverpool Range, *E. albens* comes through with the drier atmosphere, and both species are then found in the eastern area, being at times difficult to separate botanically. Just beyond the western margin of the habitat of *E. albens* occurs *E. Woollsiana*, a species closely allied in some forms to *E. hemiphloia*, but distinct from *E. albens*, with which it is often found growing. *E. hemiphloia* and *E. albens*, which are closely allied, are for the most part separated by a barrier. *E. hemiphloia* and *E. Woollsiana* are separated by the same barrier, and a greater distance, and are closely allied; while *E. albens* and *E. Woollsiana*, found side by side, differ more from one another than either does from *E. hemiphloia*. *E. viminalis* and *E. rubida*, which are closely allied species, do not support the Law, both occurring side by side, throughout the mountains, though sometimes showing slight partiality for different geological formations. *E. dives* and *E. amygdalina*, allied species, are also found together on the mountains, though the former slightly prefers the dry, and the latter the moist side of the highlands. *E. stellulata* and *E. Moorei* are closely allied, and both found on the mountains. *E. tereticornis*, *E. dealbata* and *E. Bancrofti*, all so closely allied that the latter two are some

times considered as only varieties of the former, are found in the same forest in the north-western part of the mountain-area, though the first two are sometimes found at long distances apart on the same (western) side of the mountain-barrier. *E. Banksii* and *E. Bridgesiana* are closely allied, and occur together on the northern part of the mountains. *E. coriacea* and *E. vitrea* are closely allied species, occurring together on the mountains. *E. saligna* and *E. Deanei* are closely allied, and are not separated by any barrier. *E. capitellata* and *E. macrorrhyncha*, though for the most part occurring on opposite sides of the barrier, are often found together on the mountains. *Angophora subvelutina* and *A. intermedia* are very closely allied, and in many places occur side by side.

DR. CUTHBERT HALL referred to his exhibit of a hybrid seedling from a cultivated *Acacia Baileyana* pollenised probably by *Acacia decurrens*. The seed was gathered from a cultivated tree of the former, which grew about 150 yards from a wild specimen of the latter, no other *Acacia* plant being within half a mile. The seed gave about 20% of hybrids, which appeared to be uniform, the foliage being green, the leaves larger than those of *A. Baileyana*, and the leaflets longer but not so broad and less crowded. They were, however, flatter and more crowded than those of *A. decurrens*. From inquiries made from nurserymen, it was ascertained that when seed was taken from *A. Baileyana* growing near *A. decurrens*, it invariably gave hybrids. *A. Baileyana* occurred naturally in a small area around Cootamundra; whilst *A. decurrens* inhabited the coastal area, separated by the Great Dividing Range. Yet they were sufficiently nearly allied to intercross under altered conditions; and might be considered, perhaps, geminate species.

MR. CHEEL—From a study of the genus *Callistemon*, [N.O. MYRTACEÆ] which is represented by 22 species and varieties distributed over Australia, the conclusion was, that the application of Jordan's Law in this case, fails, unless it can be proved that two reputed species were hybrids, namely, *C. speciosus* D.C., and *C. viminalis* Cheel (syn. *Metrosideros viminalis* Solander,

MS.). These two forms are allied by certain structural characters, such as, the staminal filaments shortly but distinctly united at the base into a tube, a character, possibly, of sufficient importance to justify the establishment of a Section *Tubulosæ*.) The matured fruits of both species open out very broadly at the orifice and are similar in general outline. There are certain other characters, however, by which they may be easily separated. The length of the filaments, the thickness of the rim of the fruits and its stiff upright habit readily distinguish *S. speciosus*, which is common in West Australia. The short filaments, thin-rimmed fruits, and its tall, slender, and pendulous habit as readily distinguish *C. viminalis*, common in North-Eastern New South Wales, and throughout Queensland. *C. rigidus* R.Br., and *C. linearis* DC., are both sufficiently distinct to be regarded as good species, especially as the seedlings develop the characteristics of their respective parents; but these are both found in the Port Jackson District.

DR. J. B. CLELAND.—The avifauna of Australia seems to be well-fitted, in some ways, for the study of the relationships of species. The typically Australian family of the Honey-eaters (*Meliphagidae*) affords examples of what seem to be two independent ways in which new species may be evolved. Two species of *Meliornis*, *M. novæ-hollandiæ* and *M. sericea*, are common in the neighbourhood of Sydney. They closely resemble each other in general, but the former has a white iris, when adult; and the latter, a dark brown iris, and a larger patch of white feathers near the ears. Their habits are almost identical, but there is a slight difference in the notes of the two species. The geographical range of *M. novæ-hollandiæ*, however, is more extensive than that of *M. sericea*. In West Australia, two similarly related species are found, *M. longirostris* corresponding to *M. novæ-hollandiæ*, and *M. mysticæ* to *M. sericea*. In a young specimen of *M. novæ-hollandiæ* obtained recently in the neighbourhood of Sydney, the irides were found to be of the tint of café au lait (the coffee-colour predominating), instead of enamel-white. On the universally admitted rule that, in its development, each

individual climbs up its own genealogical tree, it may be safely assumed that the ancestry of *M. novæ-hollandiæ* at one time did not possess white irides. Further, in this respect, *M. sericea* would approximate more to the original common ancestor than would *M. novæ-hollandiæ*, and thus would be like *M. australasiana*, the fifth species of the genus. The ancestors of the genus *Meliornis*, like the other species of *Meliphagidæ* whose irides have been examined, had, therefore, almost certainly, dark-coloured eyes. Now it can hardly be maintained that the striking white iris has been gradually evolved by a slow series of changes, each of which was of particular service to the individual possessing it, especially when there is seen, side by side with the species in question, another descended from the same stock, but not showing these changes. It seems more reasonable to assume that a sudden marked mutation occurred in the development of a white iris; and that, in the terms of Mendelian heredity, this feature was a dominant one, and stamped itself effectively on the offspring of the white-irised bird and its brown-irised mate. These offspring, possessing dominant white-iris characters and recessive brown ones, may be supposed to have bred more between themselves—the birds being considered to be capable of recognising the difference in colouring—than with brown-eyed fellows; and so eventually, though occupying the same habitat, a pure strain of the white-eyed type arose. As time went on, and the white-eyed birds mated with each other, to the exclusion of the brown-eyed forms, and *vice-versâ*, secondary differences such as those of plumage and note evolved; until, finally, the present-day species were firmly established. The example here quoted may be taken as an instance of the *mutational* origin of a species. That this is a highly probable explanation, will be admitted, when the case of the famous Ancon breed of sheep is borne in mind. This race, which finally bred quite true to itself, arose as a "sport" in a single animal; the special character being a dominant one, it impressed itself on the mixed offspring. But, in the difference between the West and the East Australian species of *Meliornis*, still another process is seen to be at work,

depending chiefly on the wide extension of the genus geographically. This illustrates the general type of natural selection, a process by which the fluctuating variations about a mean are taken advantage of in some particular direction in certain localities, with the development therein of races, and finally perhaps of species. What determines these fluctuations, we know not; but it seems natural to suppose, in accordance with observation, that certain conditions of environment will predispose to fluctuations in a certain direction, even though these fluctuations be seemingly of little advantage to the individual. Where the connecting links between two groups of individuals, which are developing by fluctuating variations along different lines in separated localities, have disappeared, we have then an instance of Jordan's Law, which is exemplified by the two eastern species of *Meliornis* and their two western representatives. A similar striking illustration is seen in the eastern and western species of *Psophodes* and *Falcunculus*. The Australian avifauna would seem, therefore, to furnish examples of the establishment of new species by two quite distinct processes.

The PRESIDENT summarised the views put forward. The SECRETARY thanked the Members for their cordial response to the invitation to participate in the discussion.

## WEDNESDAY, JULY 27TH, 1910.

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, July 27th, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

A letter from Professor T. W. Edgeworth David, B.A., F.R.S., C.M.G., returning thanks for greetings and congratulations from the Members assembled at last Meeting, was read from the Chair.

The Donations and Exchanges received since the previous Monthly Meeting (June 29th, 1910), amounting to 19 Vols., 81 Parts or Nos., 11 Bulletins, 2 Reports and 6 Pamphlets, received from 56 Societies, &c., and 1 Individual, were laid upon the table.

## NOTES AND EXHIBITS.

Mr. Froggatt showed specimens of *Xylotrupes nimrod*, the coconut-palm beetle and its pupæ, which ranges from New Guinea to Java. The larvæ live in decaying vegetable matter, whence the pupæ were obtained. The beetles bore into the stem of the young palm, and damage the terminal bud.

Mr. Maiden showed fruits of the Jarrah of Western Australia (*Eucalyptus marginata* Sm.) showing an irregularly striate appearance. As shown in the specimens, it is the result of the contraction of subsucculent vascular tissue over longitudinal bands of fibrovascular tissue. This appearance is only occasionally seen in *Eucalyptus* fruits, e.g., in those of Kurri (*E. diversicolor* F.v.M.). Also seedling plants of *Cassytha paniculata* R.Br., raised by Mr. Boorman, of the Botanic Gardens. He read a paragraph from Kerner & Oliver's "Natural History of Plants," (i., 176) in which the life-history of *Cassytha* seedlings is described; and the exhibitor observed that the seedlings are rarely observed in Nature, partly because of their grass-like appearance, and partly because they soon enter upon their parasitic, non-terrestrial state.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, some small fishes which he had collected at different localities along the Great Barrier Reef, Queensland, which do not appear to have been recorded from Australia. *Halichares opercularis* Gunth., and *H. nebulosus* C. and V., from Masthead Island off Port Curtis, are common species throughout the Indian and Pacific Oceans. *Acanthoclinus littoreus*



Forster, from the same locality, was previously known only from Lord Howe Island and New Zealand. *Corythoichthys waitei* Jord. and Seale, from Cairns Reef, off Cooktown, has been recently described from Samoa; while *Microphis pleurotaenia* Gunth., a Hawaiian species, is now recorded from Murray Island, Torres Strait, Cairns Reef, and Masthead Island. Mr. McCulloch also contributed the following Note on the identity of the Fresh-water Perch (*Percalates fluviatilis* Stead): "In May, 1906, Mr. Stead exhibited, before this Society, a specimen of *Percalates*, which, in consideration of its very elongate body combined with other less striking characters, he proposed to distinguish under the new name, *P. fluviatilis* (These Proceedings, xxxi., 1906, p.261). The Australian Museum has recently received a fine specimen of this form, which was caught at Unanderra, N.S.W.; and I have been able to compare it with others in the Museum collection, identified by Mr. Ogilby as *Percalates colonorum* Günth. These latter are part of the series upon which that author based his opinions published in his "Edible Fishes and Crustaceans of New South Wales," (1893, p.2). As a result of this examination, I can only come to the same conclusion as did Mr. Ogilby, namely, that the one is but a variation of the other; and that there are intermediate forms between the two extremes. Mr. Stead also stated that he considered that none of the names now taken to be synonyms of *P. colonorum* were applicable to the new form. It appears to me, however, that Steindachner's figure of *Dulus novemaculeatus* (Sitzb. Ak. Wien, liii., i., 1866, p.428, Pl. i., fig.2) exactly represents the slender form; and, beyond such differences as would be caused by shrinkage due to different methods of preservation, (alcohol, Steindachner; and formalin, Stead), it does not differ from Mr. Stead's figure published in the "Edible Fishes of New South Wales," (1908, p.54, Pl. xxii)."

Mr. T. H. Johnston exhibited a series of entozoa, comprising : (1) *Trichocephalus trichiurus* Linn., (syn. *T. dispar* Rud.) from the cæcum of the orang-utan, *Simia satyrus* Geoffr., (Sydney Zoological Gardens; from the East Indies); and (2) from *Macacus*

*namestrinus* [Melbourne Zoological Gardens (A. S. Le Souëf); from the East Indies], (3) *Dictyocaulus viviparus* Bl., (syn. *Strongylus micrurus* Mehlis) from the lung of a calf (Sydney); (4) *Nematodirus filicollis* Rud., (syn. *Strongylus filicollis* Rud.), from the small intestine of a sheep (Macleay River, N.S.W.), not previously recorded from Australia; and (5) *Coccidium* sp., infesting the submucosa of the small intestine of Parry's Wallaby, (*Macropus parryi* Bennett, South-Eastern Queensland).

Mr. E. Cheel exhibited a number of interesting fungi, including—PUCCINIACEÆ: *Puccinia calendula* McAlp.; host, *Calendula officinalis* Linn.; Penshurst (E. Cheel; July, 1910); previously recorded only from Victoria (Proc. Linn. Soc. N. S. Wales, 1903, xxviii., 558; and in "Rusts of Australia," p. 151.—HELO-TIACEÆ: *Sclerotinia sclerotiorum* Lib., (syn. *S. Libertiana* Eckl.); sclerotia and mycelium were found infesting "Epicure Beans," in a garden at Penshurst, causing great damage; not previously recorded from Australia, so far as can be ascertained.—The mycelium of an undetermined species, pendulous in habit, found in the Proprietary Mine, at Hillgrove by Mr. J. Staer, in December, 1909.—The mycelium of a radiating fungus on a board, beneath a brass plate which had been exposed on a building in Dean's Place, Sydney, for a period of eight years. *Rhizomorpha subterranea* Pers., was also shown for comparison.—PHALLOIDEÆ: *Jansia rugosa* (?); Rookwood (A. G. Hamilton).—A series of seedling tubers of potatoes, obtained from seed of the variety known as "Blue-eyed Russet," were also shown, exhibiting extreme variability in colour and shape.

In response to a request, made at last Meeting, for exhibits of the rare Protead, *Grevillea Gaudichaudii* R.Br., from the Blue Mountains, Messrs. H. Deane, A. A. Hamilton, and W. Forsyth showed specimens collected by them, more or less closely resembling the pinnatifid type-form described by Robert Brown and Mr. Bentham. Mr. Fletcher showed a remarkable series of specimens exhibiting almost every gradation between entire leaves closely resembling those of *G. laurifolia* when lanceolate,

and pinnatifid leaves with as many as thirteen lobes, some of these again 2- or 3-lobed, approximating to those of *G. acanthifolia*. On this ground, in conjunction with other reasons, the opinion was expressed that *G. Gaudichaudii* is a natural hybrid between the species named; and that the specimens shown were even strongly suggestive of reciprocal hybridism, the plants with entire or slightly divided leaves possibly representing *G. laurifolia* ♀ × *G. acanthifolia* ♂; and those with markedly pinnatifid leaves, *G. acanthifolia* ♀ × *G. laurifolia* ♂. All three species fall into Series 2 of Section i., of Mr. Bentham's tabulation: "*Hebegynæ*.—Ovary sessile or scarcely stipitate, densely villous, &c." *G. Gaudichaudii* is said to have the habit, inflorescence, and flowers of *G. acanthifolia*, and a nearly sessile densely villous ovary. The first of these characters needs amending, as *G. Gaudichaudii* is a prostrate procumbent plant like *G. laurifolia*, except perhaps when the stems are very short. On the other hand, the inflorescence and flowers of the latter are not very markedly different from those of the other two. Mature fruits or seeds of *G. Gaudichaudii* are apparently unknown or at least unrecorded.

REVISIONAL NOTES ON AUSTRALIAN *CARABIDÆ*.

BY THOMAS G. SLOANE.

## PART III.

Tribes Oodini, Chlœniini, and Sphodrini [COLEOPTERA].

## INTRODUCTORY NOTE.

Attention may be drawn to some features which have hitherto been overlooked, or have had but little attention given to them, as far as the *Carabidæ* are concerned.

(1) *Basal hair-fringe of prothorax*.—Frequently the basal socket-hole of the prothorax, to receive the peduncle of the body, is fringed with hair both above and below the peduncle (e.g., *Carenum*, *Mystropomus*, *Hyperion*); often only the upper part of the socket-hole is fringed (e.g., *Carabus*, *Pamborus*, *Delinius*, *Chlœnius*); sometimes the base is not fringed, either above or below (e.g., *Teropha*, *Secatophus*, *Eurylychnus*, *Oodes*).

(2) *Inflexed margins of elytra* when in repose, enveloped by the outer margin of the metasternal episterna. This is the usual form in the *Carabidæ*, but in the Ozæniini, Helluonini, and Brachynini the margins of the elytra are not so supported or held in position by the margins of the metepisterna.

(3) *Ventral segments bordered at sides*. This is the usual form throughout the *Carabidæ*, but in the tribes Ozæniini, Helluonini, Brachynini, Miscelini, and Pericallini; and the genera *Acrogyne*, *Lachnotherax*, *Stricklandia*, and *Pogonoglossus*, the ventral segments are merely roundly reflexed, without a border at sides.

(4) *Tactile setæ of intermediate coxæ*.—The intermediate coxæ among the *Carabidæ* usually bear two tactile setæ, and may therefore be called *biseta*. One of these setæ is placed on the lower face of the coxa, between the inner side of the coxa and

the insertion of the trochanter; this may be called the *discal seta*; the other is on the side of the coxa, below and forward from the insertion of the trochanter; this may be called the *lateral seta*. Sometimes corresponding tactile setæ may be found on the anterior coxæ (e.g., *Secatophus*, *Teropha*, *Paranurus*, *Ceratoferonia*, *Loxodactylus*, *Notonomus*, etc.). Both the anterior and intermediate coxæ may have, besides the tactile setæ, their surface more or less pubescent (e.g., *Chlæniini*), and frequently several lateral tactile setæ are found on the intermediate coxæ.

### Tribe *Chlæniini*.

Brullé, Hist. Nat. Ins. 1834.

Head with one supraorbital puncture on each side; mandibles without setigerous puncture in external scrobe. Prothorax with posterior socket-hole usually fringed with hair above peduncle; a marginal seta at, or near, each basal angle. Body not pedunculate; scutellum dividing elytra at base. Elytra bordered at base, striate, setulose at least towards sides and apex; margin interrupted posteriorly and with a distinct internal plica; ninth interstice variable in width, never linear, or situated in a furrow, or below plane of eighth. Mesosternum with intercoxal declivity deeply excavated; intercoxal parts of prosternum and mesosternum, anterior and middle coxæ setose. Posterior coxæ not raised abruptly from first ventral segment; tarsi with fifth joint setulose beneath.

The tribe, as represented in Australia, contains two genera, which may be differentiated thus:—

Head shagreened, not punctate; pronotum with only a few minute punctures; prosternum impunctate before coxæ; penultimate joint of labial palpi without setæ..... *HOLOLEIUS*.

Head more or less punctate; pronotum coarsely punctate; prosternum punctate before coxæ; penultimate joint of labial palpi with several setæ on anterior margin in all Australian species..... *CHLÆNIUS*.

### Genus *HOLOLEIUS*.

Laferté, Ann. Soc. Ent. Fr. 1851, p.274.

## HOLOLEIUS NITIDULUS Dejean.

Species, ii. p.341; Chaudoir, Ann. Mus. Civ. Genova, viii., 1876, p.290; *Chlænium ceylanicus* Nietner, Ann. Mag. Nat. Hist., 1857, xix. p.241; (?) *Pecilus ornatus* Tryon, Report Administrator Brit. N. Guinea, ii., 1890, Appendix; var. *H. punctulatus* Chaudoir, Bull. Soc. Imp. Nat. Mosc. 1857, ii. p.10.

I believe the description of *Pecilus ornatus* Tryon, is founded on this widely distributed species, which is found in Asia, as well as in the eastern coastal districts of Australia, northwards from the Clarence River.

## Genus CHLÆNIUS.

Bonelli, Obs. Ent. i., Table, 1810; Chaudoir, (Monograph) Ann. Mus. Civ. Genov. viii., pp.10-287.

There is no need for another definition of *Chlænium*, which is one of the best known genera of the *Carabidæ*; but attention may be drawn to the following features, which have received little, if any, attention, at least so far as the Australian species are concerned.

*Marginal setæ of pronotum*.—Normally, in the genus *Chlænium*, the pronotum has two marginal setæ; the anterior placed a little before the middle of the length of the pronotum, the posterior near the basal angle (e.g., *Ch. australis*, *Ch. ophonoides*, etc.); but in *Ch. subcostatus* Maccl., and *Ch. darlingensis* Cast., the anterior seta is lost, and the posterior is distant from the basal angle—somewhat similarly placed (though not quite so far forward) as in the genus *Pheropsophus*.

*Hair-fringe along basal socket of prothorax above peduncle*.—This is present in all our species except *Ch. subcostatus*,\* and *Ch. darlingensis*.

*Puncturation of posterior legs*.—In all the Australian species the posterior trochanters have, on their outer side, minute non-

\* In *Ch. subcostatus* there appears to be a scattered fringe of hairs, but a close examination will show that these arise from pores on the upper surface, near the extreme margin of the pronotum, not from the edge of the socket-hole.

setose punctures; this applies also to the outer side of the posterior femora beneath; no Australian species has the posterior femora or trochanters with tactile setæ. This is a case of lost setæ.

*Table of Australian Species.\**

- A Elytra with interstices irregular, first, third, fifth, and seventh raised into wide costæ ..... *C. greyanus* White.
- AA. Elytra with interstices regular (equal or almost so).
- B. Prothorax wide, anterior angles distant from head, basal angles obtuse; elytra with internal plica interrupting margin posteriorly, not margined with yellow (except at apex in *C. queenslandicus*), interstices with several rows of setulose punctures on every one.
- C. Elytra with interstices 1-8 unicolorous.
- d. Head and prothorax green; elytra obscure bronze with green margin, interstices pubescent; legs black..... *C. australis* Dej.
- dd. Upper surface green or purplish, legs testaceous.....  
..... *C. ophonoides* Fairmaire.
- CC. Each elytron with a testaceous mark towards apex.
- E. Elytra green, apical marks comma-shaped and extending backwards to margin of apex..... *C. queenslandicus* Sl.
- EE. Elytra black or dark green (including margin of apical curve), bimaculate at beginning of apical declivity.
- f. ♂. Anterior femora bearing a small dentiform projection on lower side near base. (Antennæ, after three basal joints, infuscate; legs testaceous, coxæ, knees, inner side of apex of tibiæ and tarsi black or piceous; palps black).....  
..... *C. binotatus* Dej.
- ff. ♂. Anterior femora not bearing a dentiform protuberance on lower side.
- g. Antennæ and palps brown; legs black or piceous.....  
..... *C. maculiger* Casteln.
- gg. Antennæ, palps, and tarsi brownish-testaceous; legs testaceous (coxæ piceous). .... *C. rudicollis* Chaud.

\* For synonymy of Australian species, not noticed separately in this paper, see Masters' Catalogue, Supplement, Part i., 1895.

† To the synonymy of *Ch. binotatus* Dej., given by Masters, *i.e.*, should be added *Ch. maculiger* Cast., (*teste* Chaudoir, Ann. Mus. Civ. Genov. viii. 1876, p. 48).

BB. Prothorax narrow, sides straight before base, anterior angles close to head, basal angles sharply marked; elytra with internal plica not interrupting margin posteriorly, margin yellow, interstices biserially setulose-punctate.

h. Interstices of elytra lightly raised into costiform rather nitid ridges.  
..... *C. subcostatus* MacL.

hh. Interstices of elytra roundly convex, shagreened .....  
..... *C. darlingensis* Casteln.

#### CHLÆNIUS QUEENSLANDICUS, n.sp.

♀. Green, metallic on prothorax and head; prothorax with narrow testaceous border; elytra opaque, setulose-punctate, with testaceous marking on apical third (this testaceous marking having the width of interstices 6-8, sinuate-truncate at base and bending inwards across interstices 4-5, extending backwards on interstices 6-8, and reaching along apical margin of each elytron to suture); undersurface piceous-black, prosternal episterna iridescent, apex of abdomen narrowly margined with yellow; legs testaceous, tarsi brownish-testaceous; antennæ and palpi brownish-testaceous, with basal joints more lightly coloured; labrum and mandibles testaceous-brown.

Head convex, finely punctate, 2.5 mm. across eyes. Prothorax transverse (3 × 3.85 mm.), much wider across base (3.4 mm.) than apex (2.3 mm.), punctate, less closely so towards middle of disc, more finely and closely so towards base; sides lightly rounded, strongly narrowed to apex, roundly and gently narrowed to base; apex emarginate; anterior angles not marked; base truncate; basal angles wide; lateral basal impressions shallow, wide. Elytra ovate (7.8 × 5 mm.), lightly convex, finely punctate-striate, interstices depressed, closely setulose-punctate, the setulæ short, yellowish. Prosternum punctate before coxæ, finely bordered at base; episterna lævigata (with only two or three punctures near coxal cavities). Mesosternal episterna smooth, with only a few fine punctures. Metasternum punctate on each side below intermediate legs; episterna sulcate externally, sparingly punctate. Ventral segments smooth. Length 12.5, breadth 5 mm.

*Hab.*—Q: Kuranda (Dodd).



The comma-like testaceous mark towards the apex of each elytron at once separates this species from all the other Australian species; its position in the genus is beside *Ch. bihamatus* Chaudoir, a Javan species.

*CHLÆNIUS MACULIGER* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.148; Chaudoir, Ann. Mus. Civ. Genov., viii., 1876, p.67; Maindron, Résultats Exped. Scient. Néerland. Nouv. Guinée, v. 2, 1908, p.295; *Ch. nigripes* Macleay(not Dejean), Proc. Linn. Soc. N. S. Wales,(2) i., 1886, p.140.

I compared a specimen from Kuranda, in my collection, with Macleay's type of his *Ch. nigripes*, in the Australian Museum, Sydney, and found them to be one species.

*Hab.*—Q.: Rockhampton(*fide* Castelnau), Kuranda(Dodd)—New Guinea: Fly River(Froggatt; *fide* Macleay), Manikion(*fide* Maindron).

*CHLÆNIUS RUDICOLLIS* Chaudoir.

Ann. Mus. Civ. Genov., viii., 1876, p.47; *Ch. bimaculatus* Macleay(not Dejean), Trans. Ent. Soc. N. S. Wales, i., 1864, p.115.

Baron Chaudoir, in his Monograph of 1876, when redescribing and renaming Macleay's *Ch. bimaculatus*, placed it in a group characterised by having the *anterior femora in ♂ dentate beneath*; but, in this assignment, he was wrong. I have examined the type-specimen(♂), in the Macleay Museum, and found it to have the anterior femora *edentate* beneath, as is also the case with a specimen(♂) sent to me by Mr. F. P. Dodd. Its position is near *Ch. maculiger* Cast.

*Hab.*—Q.: Port Denison(Masters; *fide* Macleay); Chillagoe District(Dodd).

*CHLÆNIUS DARLINGENSIS* Castelnau.

Trans. Roy. Soc. Vict., viii., 1868, p.148; *C. marginatus*, Cast., (not Dejean) *ibid.*; *C. lateviridis* Chaud., Ann. Mus. Civ. Genov., viii., 1876, p.109.

Chaudoir, in his Monograph, gave the name of *C. lateviridis* to the Australian species which Castelnau had taken for *C. marginatus* Dej.; and, at the end of his note, says *C. darlingensis* is only a specimen with lightly convex interstices. Seeing that one of Castelnau's names is valid according to the rules of nomenclature, there seems to have been no reason for a new name from Chaudoir.

### Tribe Oodini.

Laferté, Ann. Soc. Ent. Fr., 1851, p.214; Chaudoir, (Monograph) Ann. Soc. Ent. Fr., 1882(6), p.317.

Some species of the tribe Oodini have two supraorbital punctures on each side of the head. I have noticed this character only in *Anatrichis australasie* Chaud., *A. pusilla* Sl., *A. sexstriatis* Sl., *Oodes modestus* Cast., *O. impressus* Chaud., and *O. bostocki* Cast. The hind puncture is placed above the posterior third of the eye, and bears a fully developed tactile seta; this puncture and seta are invariably present throughout the tribe Oodini. The other puncture, which I have noticed only in the species mentioned above, is small, shallow, and without a seta (only once, in a specimen of *O. modestus*, have I noticed a minute setule in this puncture, on one side of the head). The presence of this small puncture, in these few species, must be considered a rudimentary character, indicating that the Oodini are descended from a stem which had two supraorbital punctures; and, if due weight be given to this clue of origin, the view of Chaudoir, that the Oodini are a tribe coordinate with the Chlœniini, must be upheld against G. H. Horn's idea, that the Oodini were only a subtribal division of the Chlœniini. This tribe may be briefly defined as follows:—

Head with one fully developed supraorbital seta rising from a puncture above posterior third of eye (rarely a second non-setigerous puncture is present above anterior third of eye). Mandibles without a setigerous puncture in outer scrobe. Penultimate joint of labial palpi without tactile setæ. Prothorax glabrous; posterior socket-hole not fringed with hair above

peduncle; lateral margins normally without setæ (only in *O. oblongus*, and *O. inornatus* Cast., have I found a marginal seta near each basal angle). Body not pedunculate; scutellum dividing elytra at base. Elytra bordered at base, striate, glabrous; margin interrupted posteriorly and with a distinct internal plica; ninth interstice linear, and placed in a marginal furrow. Mesosternum with intercoxal part deeply excavated; intercoxal part of prosternum and mesosternum, and anterior and middle coxæ not pubescent. Middle coxæ bisetose; posterior coxæ not raised abruptly from first ventral segment; tarsi with fifth joint glabrous beneath.

According to Chaudoir's classification, the Australian fauna contains three genera of Oodini; and though the differences which distinguish these three genera seem to me hardly of full generic importance, yet, seeing that often there must be varying opinions on the status of such groups, it has seemed best to recognise Chaudoir's views on the subject, rather than to reduce *Anatrichis* and *Coptocarpus* to subgenera of *Oodes*. I tabulate our genera thus:—

*Olypeus* without setigerous punctures. (Labrum with anterior margin trifoveolate, the median fovea with two or four fine setæ. In male, anterior tarsi with two basal joints lightly dilatate and squamose beneath, third and fourth joints smaller, subequal in width)..... ANATRICHIS.

*Olypeus* bisetigerous.

Elytra with first stria lightly deflexed considerably behind scutellum, and reaching puncture at base of second stria; scutellar striae elongate (rarely obsolete or obsolescent). Prosternum with intercoxal part usually not bordered (bordered in *O. latus* Cast., *O. inornatus* Cast., and *O. parviceps* Sl.). Fourth and fifth ventral segments bisetigerous. In male, three basal joints of anterior tarsi dilatate and spongiöse beneath, fourth joint attached to third in middle..... OODES.

Elytra with first stria parallel with suture to, or almost to, its basal extremity, not attaining puncture at base of second stria. Scutellar striae obsolete, or very short. Prosternum with intercoxal part bordered. Fourth and fifth ventral segments without ambulatorial setæ. In male, three basal joints of anterior tarsi very widely dilatate and spongiöse beneath, fourth joint small, narrow, attached to third near innerside ..... COPTOCARPUS.

## GENUS ANATRICHIS.

Leconte, Trans. Am. Phil. Soc., x., 1853, p.391.

## Table of Australian Species.

A. Elytra fully striate.

B. Black species.

C. Elytra strongly rounded on sides; disc convex when viewed from the side; striae deep, coarsely punctate, third and fourth reaching basal border; scutellar striae elongate, strongly impressed, punctate.....*A. australasie* Chaud.

CC. Elytra lightly rounded on sides; disc depressed behind scutellum; striae finely impressed, lightly punctate, none of those outside the second reaching base; scutellar striae short, consisting of two or three punctures.....*A. pusilla* Sl.

B. Species with bronzy elytra.....*A. lilliputana* MacI.

AA. Elytra with seventh stria wanting.....*A. sexstriata* Sl.

## ANATRICHIS AUSTRALASIE Chaudoir.

Ann. Soc. Ent. Fr., 1882 (6) ii., p.322; *Oodes pygmaeus* MacI, Proc. Linn Soc. N. S. Wales, (2) iii., 1888, p.464.

I have examined the type of *O. pygmaeus* MacI., in the Macleay Museum, and found it identical with the common Queensland species, which I identify, from Chaudoir's description, as *A. australasie* Chaud. I found this species common about the edges of sandy and stony pools that remained in the beds of the creeks near Cooktown, Kuranda, and Townsville, in June, 1906; also, once I took a specimen in the flood-waters of the Murray River, at Mulwala, N. S.W.

## ANATRICHIS PUSILLA, n.sp.

Oval, convex. Labrum with three setigerous foveoles along anterior margin, median foveole bearing four fine setae. Maxillary palpi with penultimate joint shorter than apical joint. Two supraorbital punctures above eyes, the posterior puncture bearing a fully developed seta, the anterior puncture small (rudimentary) and without a seta. Prothorax with a distinct round fovea on each side a little distance from the basal margin, opposite extremity of third elytral stria. Elytra convex, crenate-striate;

scutellar striae short, feebly indicated by two or three punctures, seventh stria strongly impressed; interstices flat, third minutely 2-punctate; humeral angles minutely dentate.

Black; sides of prothorax (widely near base) and reflexed border mandibles, and labrum piceous-red; legs and three basal joints of antennæ ferruginous; antennæ fuscous after third joint. Length 5.2, breadth 2.2 mm.

*Hab.*—Q.: Kuranda (Sloane).

The smallest Australian species. It differs decidedly from *A. australasic* Chaud., by much smaller size; more parallel and less convex form; prothorax with basal foveæ; elytra more finely striate, the striae much more finely crenulate, interstices not the least convex. From *A. lilliputana* MacL., it differs by colour not bronzy; scutellar striae not "three times the length of scutellum," etc. Its place in the genus is apparently beside *A. indica* Chaud., (unknown to me in nature) with the description of which it agrees by the form of the basal foveæ of the prothorax, the eighth interstice of the elytra not narrower than the seventh, nor narrowed to the base, colour, etc.; but it is smaller. Under a lens of high power, it is seen that the derm of the head, prothorax, and elytra is minutely punctulate. Two specimens occurred to me, washed from the banks of a pool in a creek, near Kuranda, in June, 1906.

#### ANATRICHIS SEXSTRIATA Sloane.

My localities for this species are Vic.: Moonbulk (D. A. C. McGill)—N.S.W.: Mulwala and Grenfell (Sloane), Wyong (H. Cox).

#### Genus Oodes.

Bonelli, *Observ. Ent. i.*, 1810; Chaudoir, *Ann. Soc. Ent. Fr.*, 1882(6), p. 341.

#### Table of Australian Species known to me.

i. Prosternum with intercoxal part bordered. Humeral angles of elytra marked (subdentiform). Colour black.

A. Metepisterna elongate, bordered and strongly sulcate along anterior and inner sides, outer margin strongly raised. (Prothorax with a fine seta on each side of base a little within basal angle).....

.....*O. inornatus* Cast.

- AA. Metepisterna but little longer than broad, bordered, but not sulcate, along inner side, outer margin not strongly raised.. *O. parviceps* Sl.
- ii. Prosternum with intercoxal part not bordered. Humeral angles of elytra edentate
- B. Black species.
- C. Opaque. Elytra finely and lightly striate; interstices flat, bearing some minute punctures. (Prothorax with a fine seta on each side of base a little within basal angle). Size large, 12.5-14 mm. .... *O. oblongus* Cast.
- CC. Nitid. Elytra finely, but decidedly, striate; interstices without minute punctures. (Male with intermediate tibiae arcuate). Size small, 9-10.5 mm.
- D. Elytra finely and simply striate; scutellar striae faintly indicated by a row of punctures; interstices quite flat. Size 10.5 mm. .... *O. trisulcatus* Cast.
- DD. Elytra more strongly striate; scutellar striae strongly impressed; interstices subconvex. Size 9-10 mm. .... *O. fitzroyensis* MacL.
- BB. Bronzed species.
- E. Labrum with six separate setigerous punctures along anterior margin.
- F. Elytral striae strongly crenulate; ninth interstice forming a narrow border to eighth. Intermediate tibiae in male arcuate. Size large, 14.5 mm. .... *O. denisonensis* Cast.
- FF. Elytral striae finely crenulate, or subcrenulate, under a lens; ninth interstice not forming a border to eighth. Intermediate tibiae in male not bent.
- G. Size large, 12.5-13.5 mm.
- H. Elytra with marginal channel constricted near base; interstices subconvex; scutellar striae strongly impressed. .... *O. waterhousei* Cast.
- HH. Elytra with marginal channel not constricted near base; interstices quite flat; scutellar striae feebly marked. .... *O. froggatti* MacL.
- GG. Size small, 9-11 mm.
- J. Elytral striae and interstices as in *O. waterhousei*; scutellar striae well marked. Prothorax with evident lateral basal impressions. .... *O. impressus* Chaud.
- JJ. Elytra finely striate; interstices depressed; scutellar striae faint. Prothorax not perceptibly impressed on each side of base. .... *O. modestus* Cast.
- EE. Labrum with three punctures (middle puncture bearing four fine setae) along anterior margin. .... *O. bostocki* Cast.

Note—*O. latus* Casteln., and *O. paroensis* Casteln., are unknown to me in nature. *O. latus* seems, from Chaudoir's description (Ann. Soc. Ent. Fr., 1882 (6), p.344), to resemble *O. parviceps* Sl.; but to differ by having the shoulders not dentate, the legs and antennæ darker. *O. paroensis* Cast., is not noticed by Chaudoir in his monograph; but, from consideration of Castelnau's slight description, it seems nearly related to (if not identical with) *O. oblongus* Casteln. *O. reichei* Laf. (nomen nudum) = *Coptocarpus convexus* Cast.; cf. Chaud. Mon. p.510.

#### ODES INORNATUS Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.151; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.343; *O. proximus* Casteln., l.c.

It is on the authority of Chaudoir, in his Monograph (p.344), that *O. proximus* has been placed as a synonym of *O. inornatus*. I have identified this species from Chaudoir's description.

Hab.—N.S.W.: Junee (Sloane)—Vic.: Birchip (Goudie).

#### ODES PARVICEPS Sloane.

Rept. Horn Exped., Zool., 1896, p.382.

Hab.—Central Australia: Paisley Bluff, MacDonnell Ranges (Spencer)—Q.: Mt. Garnet District (inland from Cairns; Dodd).

#### ODES OBLONGUS Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.149; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.360; *Coptocarpus riverince* Macleay, Trans. Ent. Soc. N. S. Wales, 1873, ii., p.329; *C. planipennis* Macleay, Proc. Linn. Soc. N. S. Wales, ii., 1878, p.216.

This species has an extensive range, but I have never yet found it. Castelnau's type was from Eastern Creek, near Sydney. I have inspected the types of *Coptocarpus riverince* MacL., in the Macleay Museum, and have no hesitation in referring them to *O. oblongus*. The types of *O. planipennis* MacL., in the Macleay Museum, though more nitid, evidently represent this species, and have a fine marginal seta within each basal angle of the prothorax. Below, under *O. froggatti*, will be found some features which differentiate the type-speci-

mens of *O. planipennis* and *O. froggatti*; all the characters there attributed to *O. planipennis*, are also found in *O. oblongus*.

*ODES TRISULCATUS* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.150; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.362.

I have identified this species from the descriptions of Castelnau and Chaudoir.

*Hab.*—Q.: Port Denison(*vide* Castelnau), Townsville and Kuranda(Dodd).

*ODES FITZROYENSIS* Macleay.

Proc. Linn. Soc. N. S. Wales,(2), iii., 1888, p.464.

My specimens were given to me by Mr. C. French, as from the Burketown District, Gulf of Carpentaria; and have been compared with Macleay's types.

*Hab.*—Q.: Gulf of Carpentaria—W.A.: King's Sound(Froggatt; *teste* Macleay).

*ODES DENISONENSIS* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.150; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.363.

*Hab.*—Q.: Port Denison(*vide* Castelnau), Townsville (Dodd)—Northern Territory: Pine Creek(*vide* French).

*ODES WATERHOUSEI* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.149; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.364; *O. interioris* Cast., *l.c.* p.150.

A widely distributed species.

*Hab.*—N.S.W.: Grenfell District(Sloane)—Q.: Cooper's Creek (*teste* Castelnau), Winton(*vide* French)—Central Australia: Lake Callabonna(Ziets), MacDonnell Ranges(Spencer).

*ODES FROGGATTI* Macleay.

Proc. Linn. Soc. N. S. Wales,(2), iii., 1888, p.463.

This species requires differentiating from *O. planipennis* Macleay. I have examined the types of both species in the Macleay Museum, and found the following differences:—



*O. froggatti* Macleay.

Type, ♂, (unique). Colour, shining bronzy. No seta at posterior angle of prothorax. Elytra without scattered minute punctures on interstices; no trace of scutellar striae at base of first interstice; a large foveiform puncture at origin of first and second striae.

*O. planipennis* Macleay.

Types, ♂, two specimens. Colour, black. A seta at posterior angle of prothorax. Elytral interstices minutely punctate; scutellar striae at base of first interstice present; a fine puncture at origin of first and second striae.

*OODES IMPRESSUS* Chaudoir.

Ann. Soc. Ent. Fr., 1882 (6), p.365.

I have identified, from the description, specimens found in Western Australia (Boverley and Rottnest Island) by Mr. A. M. Lea, as *O. impressus* Chaud.

*OODES MODESTUS* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.149; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.366.

Widely distributed in Tasmania and South-Eastern Australia (New South Wales, Victoria, and South Australia).

*OODES BOSTOCKI* Castelnau.

Trans. Roy. Soc. Victoria, viii., 1868, p.151; Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.367.

Mr. French has given me a specimen from the Gulf of Carpentaria, which I identify as this species, from the descriptions of Castelnau and Chaudoir. Castelnau gave Nickol Bay as the locality.

Genus *COPTOCARPUS*.

Chaudoir, Bull. Soc. Imp. Nat. Mosc., 1857, ii., p.59; Ann. Soc. Ent. Fr., 1882 (6), p.507.



as *C. championensis*, which seems to me rather a local form of *C. convervus* than a distinct species. The less strigulose-opaque mesepisterna, without punctures on the surface, except at bottom of channel to receive the intermediate femora, is the only decided character by which I can differentiate this form. Length 8.5-9.2, breadth 3.9-4.5 mm. (Chaudoir gives the size as "Long.  $8\frac{1}{2}$ - $9\frac{1}{2}$ , larg.  $3\frac{3}{4}$ - $4\frac{1}{2}$  mill.")

COPTOCARPUS CHAUDOIRI Macleay.

Trans. Ent. Soc. N. S. Wales, ii., 1873, p.329.

This is the northern form representing *C. australis* Dej.; from which it seems distinguished chiefly by its nitid sternal side-pieces without punctures on their surface, the basal ventral segments nitid, the second not closely covered with a fine puncturation.

COPTOCARPUS DODDI, n.sp.

Oval, convex, nitid; labrum 6-setose; prothorax without basal impressions; elytra truncate-oval, strongly striate, striae crenulate, first interstice without striae at base, third interstice bi-impressed on apical half; prosternum with intercoxal part bordered, episterna with a few punctures near coxal cavities; mesepisterna smooth (only punctate at bottom of femoral channel); metepisterna broader than long, impunctate; ventral segments impunctate; anterior tarsi in ♂ with three basal joints widely dilatate, fourth joint attached to third near inner side. Black, shining; lateral margins of prothorax piceous-red; antennae and palpi reddish; tarsi reddish-piceous.

Head wide (1.6 mm. across eyes), short; eyes round, convex, inclosed behind. Prothorax convex, declivous to sides (strongly so anteriorly, lightly so posteriorly), wide (2.3 x 3.7 mm.), widest just before base, about twice as wide at base (3.65 mm.), as at apex (1.8 mm.), minutely shagreened under a lens; sides narrower anteriorly in an even curve; apex decidedly emarginate; anterior angles widely obtuse; base very slightly emarginate, hardly tri-angulate; basal angles subrectangular but obtuse at summit; median line fine, sometimes hardly perceptible. Elytra wide,

short( $5 \times 3.8$  mm.), very little wider than prothorax, convex, strongly and roundly declivous to apex; sides subparallel towards base; apex widely rounded; striae 4-7 not reaching base, seventh and eighth interstices uniting near apex to form a narrow convex costa. Apical ventral segment in ♂ with a conspicuous foveiform setigerous puncture on each side of middle; in ♀ with four setigerous punctures near apical margin. Length 8.9, breadth 3.8-4.1 mm.

*Hab.*—N.T.: Port Darwin(Dodd). Coll. Sloane.

A very distinct species, differing from all others with the metepisterna short, by its impunctate mes- and metepisterna, and ventral segments; from other species, except *C. impar* Sl, it differs by size smaller, elytra more strongly striate, etc.; from *C. impar* it differs by its short, wide, more convex form(both prothorax and elytra much shorter), etc.

#### COPTOCARPUS NITIDUS Macleay.

Trans. Ent. Soc. N. S. Wales, ii., 1873, p.330; *C. oviformis* Chaudoir, Ann. Soc. Ent. Fr., 1882 (6), p.511.

I have inspected one type-specimen(♀) of *C. nitidus* MacL., in the Macleay Museum. I consider, from Chaudoir's description, that *C. oviformis* Chaud., is synonymous with it. *C. nitidus* has, from type, the metepisterna short, impunctate; mesepisterna impunctate, except at bottom of femoral channel.

#### COPTOCARPUS GIBBUS Chaudoir.

Ann. Soc. Ent. Fr., 1882 (6), p.511.

I have identified this species from Chaudoir's description. The female is very convex, the male less so. It is variable in size, length 10-13, breadth 4.1-5.3 mm.

*Hab.*—W.A.: Albany(Helms), Bunbury and Mount Barker (Lea).

#### COPTOCARPUS IMPAR, n.sp.

♂. Elliptical, narrow; labrum 6-setose; prothorax trapezoid; elytra truncate-oval, strongly crenulate-striate, interstices

shagreened under a lens, third interstice bipunctate, humeral angles marked but not dentiform; metepisterna quadrate, not longer than broad, bearing a few (three or four) punctures; anterior tarsi with second and third joints very widely dilate. Black, shining; antennæ and tarsi ferruginous.

Head elongate (1.8 mm. across eyes), convex; eyes prominent, distant from anterior angles of prothorax. Prothorax broader than long ( $2.63 \times 3.6$  mm.), widest about basal fourth, much narrower at apex (1.9 mm.) than at base (3 mm.), subdepressed towards base, shining, but minutely shagreened under a lens; sides lightly arcuate, subobliquely narrowed anteriorly; apex lightly emarginate; anterior angles not prominent, obtuse but marked; base lightly trisinate; basal angles sharply marked but obtuse at summit; lateral border narrow; median line faintly indicated on disc; a lightly marked basal impression on each side opposite fourth interstice of elytra. Elytra shining, a little wider than prothorax ( $6 \times 3.8$  mm.), lightly convex; sides lightly rounded, bending in a long gentle curve to apex; striæ finely crenulate, extending in full depth to apex, 4-7 not reaching base, sixth and seventh terminating abruptly some distance from base, seventh strongly impressed; second, fourth, and sixth interstices wider than the alternate ones. Prothorax with a few punctures on each side; episterna smooth but bearing a number of strong punctures. Mesepisterna strongly punctate. First and second ventral segments punctate, 3-6 smooth; sixth in ♂ with a setigerous puncture on each side of middle, in ♀ with four setigerous punctures near apical margin. Length (♂. Roebuck Bay) 10, breadth 3.8 mm.

♀. Differs from ♂ by upper surface opaque, owing to being far more strongly shagreened. Length (♀. Shark's Bay) 8.2, breadth 3.6 mm.

*Hab.*—W.A.: Shark's Bay, Roebuck Bay. Coll. Sloane.

I owe two specimens of this species to the generosity of Mr. C. French. It is evidently a much narrower species than *C. thoracicus* Cast., unknown to me in nature, and which Chaudoir describes as resembling *C. oviformis* Chaud., not more elongate.

From Chaudoir's description of *C. oriformis*, I conclude that *C. impar* must differ from that species by eyes less convex; prothorax with sides less rounded, basal angles more sharply marked; elytra with apex much more acutely rounded.

### Tribe Sphodrini.

*Sphodridæ* Castelnau, Etud. Entomol., 1834, p.78; Bedel, Faune Col. Bas. Seine, 1881, p.102: *Platynides* Lacoste, 1853; *Platynini* Horn, Trans. Am. Ent. Soc., ix., p.141; Sloane, Proc. Linn. Soc. N.S. Wales, 1903, xxviii., p.631.

Priority indicates that, if this tribe is to be recognised, as I believe it should be, the tribal name must be Sphodrini, not Platynini.\* It is not necessary to define the tribe again.

### Table of Australian Genera.

- A. Elytra without dorsal punctures. Tarsi hairy above (ungues with several teeth near base)..... LÆMOSTENUS.
- AA. Elytra with dorsal punctures on third interstice. Tarsi glabrous above.
  - B. Tarsi with fourth joint entire, of interior tarsi small, much narrower than third joint.
    - C. Ungues simple ..... PLATYNUS.
    - CC. Ungues with a single long sharp tooth on inner side near base..... DICRANONCUS.
  - BB. Tarsi with fourth joint (of four anterior tarsi at least) bilobed, in anterior tarsi almost as wide as third joint... COLPODES.

### Genus LÆMOSTENUS.

*Pristonychus* Dejean, 1828, is now regarded as a synonym of *Læmostenus* Bonelli, 1810.

### LÆMOSTENUS COMPLANATUS Dejean.

*Pristonychus australis* Blackburn, must be regarded as one of the numerous synonyms of this universally distributed species,

\* European coleopterists (including Bedel, but not Tschitschérine) have considered, in recent years, this tribal name unnecessary; and (following Schaum) have included it in the tribe Pterostichini; but I am not yet convinced of the correctness of this view.

which has evidently been introduced into Australia. Chaudoir recorded *L. complanatus* from Australia in 1874;\* and, according to Bedel, *P. australis* Blkb. = *L. complanatus*.†

Genus *PLATYNUS*.‡

Bonelli, Observ. Ent. 1810.

*Table of Australian Species.*

A. Tarsi with fifth joint glabrous beneath.

B. Elytra with eighth interstice not narrow and convex at apex.

c. Prothorax transverse, strongly narrowed on sides to base and apex.

d. Elytra viridæneous, with narrow testaceous margin; legs pale .....  
..... *P. marginicollis* MacL.

dd. Elytra obscure; legs fuscous..... *P. marginellus* Er.

cc. Prothorax elongate (one-sixth broader than long, *vide* Blackburn),  
gently narrowed to base and apex..... *P. murrayanus* Blkb.

BB. Elytra with eighth interstice narrow and convex at apex (size small).

E. Prothorax widely margined, posterior angles not marked; elytra  
strongly striate, punctures of third interstice small... *P. macleayi* Sl.

EE. Prothorax narrowly margined, posterior angles marked; elytra  
finely striate, punctures of third interstice large, foveiform.....  
..... *P. cooki* Sl.

AA. Tarsi with fifth joint setulose beneath. (Prothorax narrow, elytra  
wide, purple)..... *P. porphyriacus* Sl.

*PLATYNUS MACLEAYI*, n.sp.

Winged, oval, depressed; elytra strongly striate, interstices lightly convex, third 3-punctate, eighth narrow and convex at apex; tarsi with fifth joint glabrous beneath. Black; legs and mouth-parts brownish-testaceous, antennæ more infuscate; explanate margins of prothorax piceous-brown.

\* Ann. Soc. Ent. Belge, xix., p.124.

† Cat. Raisonné Col. N. Af., p.200(1900). See also Sloane, These Proceedings, 1903, p.631.

‡ Bedel, in his Catalogue Raisonné des Coléoptères du Nord de l'Afrique, p.216(1902) has the following note--"Le nom d'*Agonum* Bon., est antérieur à celui de *Platynus* Bon., adopté dans la plupart des ouvrages récents." Probably this contention is strictly correct; though I am not prepared to discard the name *Platynus* without further evidence.

Head smooth, lightly and widely impressed on each side of front; eyes convex, reniform. Prothorax broader than long (1.4 x 2 mm.), widest at anterior marginal puncture, rounded on sides, more strongly so to apex than to base; anterior margin lightly emarginate, finely bordered; anterior angles obtuse; base arcuate-truncate; basal angles obtuse, lateral margins wide, wider towards base than apex, very wide and upturned at basal angles; lateral basal impressions deeply concave, wide, margined externally by the explanate lateral margins; disc rather convex, strongly canaliculate. Elytra ovate (4.7 x 2.8 mm.); humeral angles rounded; apical curve lightly obliquely sinuate on each side, apex itself rounded; striae deep, simple; third interstice with a fine puncture near third stria at anterior fourth, and two other similar punctures near second stria on posterior half; eighth interstice a little wider than ninth on sides, narrow and convex towards apex. Anterior tarsi of ♂ with three basal joints dilatate and squamulose beneath; fourth joint small, sub-emarginate; four posterior tarsi with fourth joint small, entire; ungues simple. Length 7, breadth 2.8 mm.

*Hub.*—Q.: Kuranda (Dodd). Coll. Sloane.

This species is readily separated from all the other described Australian species by its convex elytral interstices. It is very different from *P. cooki* Sl., by its wider prothorax, more widely margined, posterior angles not marked; elytral interstices not depressed, punctures of third not foveiform; eyes less prominent, etc. From the description of the Papuan species, *P. papuensis* Sl., it offers the following evident differences—legs and antennae not “pitchy black”; posterior angles of prothorax not marked, elytral interstices not “flat.”

#### PLATYNUS PORPHYRIACUS, n.sp.

Winged, oval, subdepressed; prothorax small, subquadrate; elytra strongly striate, third interstice 3-punctate, eighth depressed at apex; tarsi with fourth joint small, entire, fifth joint setulose beneath. Elytra purple (of a dark tint), reflexed margins dark piceous; prothorax and head black; vertex, mandibles,



labrum, antennæ, under part of head, metasternum, coxæ, tibiæ towards apex, and tarsi more or less reddish-piceous.

Head elongate, convex (1.75 mm. across eyes). Prothorax narrower than head with eyes (1.5 x 2 mm.), widest a little before middle, not ampliate or rounded on sides; disc finely transversely striolate; border not wide, reflexed, more widely so and sub-sinuate posteriorly; lateral channel wide, developed posteriorly into a strongly marked wide lateral impression on each side; median line strongly marked, extending from the deep arcuate anterior impression to the wide basal depression. Elytra truncate-oval, twice as wide as prothorax (6.2 x 4 mm.), lightly convex, declivous to base; humeral angles rounded; apex of each elytron obliquely subtruncate; striæ deep, finely crenulate; third interstice with a fine setigerous puncture placed in a light depression about 1 mm. from base, second puncture about middle of length, third about posterior fourth; eighth interstice wider than ninth, narrower but not convex, towards apex. Length 10, breadth 4 mm.

*Hab.*—N.S.W.: Illawarra (Carter; type); Blue Mountains (Mount Irvine; Ferguson).

At once distinguished from all Australian congeners, by colour; small narrow prothorax; fifth joint of tarsi setulose beneath.

Note—Near the base of the unguis of the tarsi, a very small nodule is perceptible at the position of the tooth which is so prominent in *Dicranoncus*.

#### Genus DICRANONCUS.

Chaudoir, Bull. Soc. Imp. Nat. Mosc., 1850, ii., p.392.

DICRANONCUS QUEENSLANDICUS Sloane.

*Platynus queenslandicus*, Sloane, Proc. Linn. Soc. N. S. Wales, 1903, xxviii., p.633.

*Platynus queenslandicus*, Sl., must be referred to the genus *Dicranoncus*, the tarsi having the fifth joint setulose beneath,

and the unguis bearing a single strong sharp tooth on the inner side near the base—features which escaped my notice when describing this species.

My description was founded on a specimen(♀), evidently slightly discoloured by age; a fresh specimen(♂) received from Mr. F. P. Dodd, is much brighter; it is coloured as follows. Head clear yellowish-brown; prothorax nitid, piceous with a median stripe of the same colour as head; explanate margins testaceous(the prothorax has on each side of the disc a wide infuscate area fading to a yellowish colour towards middle, apex, and base); elytra piceous-black, subopaque with lateral margins, lateral border, and suture(narrowly)testaceous; under surface, inflexed margins of elytra and legs pale testaceous; antennæ and anterior tarsi slightly darker than legs.

*Hab.*—Q.: Kuranda(Dodd).

#### Genus COLPODES.

Macleay, W. S., *Annulosa Javanica*, 1835, p.17; Chaudoir (Monograph), *Ann. Soc. Ent. Fr.*, 1877.

The two Australian species may be differentiated thus :—

Colour aeneous. Elytra with apex rounded, unarmed....*C. lafertei* Montr.  
 Colour violaceous. Elytra bispinose at apex..... *C. violaceus* Chaud.

#### COLPODES LAFERTEI Montrouzier.

*Anchomenus lafertei* Montrouzier, *Ann. Soc. Ent. Fr.*, 1860, p. 238; *Colpodes lafertei* Chaudoir, *Ann. Soc. Ent. Fr.*, 1877, p.341: *Platynus planipennis* Macleay, *Trans. Ent. Soc. N. S. Wales*, ii., 1871, p.112.

*Platynus planipennis* Maccl., agrees so well with Montrouzier's brief note on his *Anchomenus lafertei*, and with Chaudoir's note on the same species, in his *Revision*(1877), that (considering, also, Bates's having recorded *C. lafertei* from Australia), I feel certain it is the same species. My former note, suggesting its probable identity with *Platynus marginellus* Erichs., was quite wrong. It is a *Colpodes*.

*Hab.*—Australia: Eastern Coastal Districts, from Kuranda, Q., (Dodd) to Ourimbah, N. S. W. (Sloane)—New Caledonia.

COLPODES VIOLACEUS Chaudoir.

Ann. Soc. Ent. Fr., 1859, p.351; *C. mucronatus* Macleay, Proc. Linn. Soc. N. S. Wales, (2) ii., 1887, p.218.

I have seen specimens of *Colpodcs violaceus* Chaud., from New Guinea; and, on comparing them with *C. mucronatus* Macleay, from North Queensland, could find no difference; therefore, I cannot doubt but that Macleay's species is conspecific with Chaudoir's.

# POLYMORPHISM AND LIFE-HISTORY IN THE DESMIDIACEÆ.

BY G. I. PLAYFAIR.

(Plates xi.-xiv.)

The present paper is to some extent a reply to certain criticisms of my statements in previous papers, regarding the growth of Desmids. Originally made to myself in some correspondence with which I was favoured, these have recently appeared in print in "The Algae of the Yan Yean Reservoir," by Dr. G. S. West, F.L.S. (Journ. Linn. Soc. Bot., Vol. xxxix, 1909). On page 44, Dr. West remarks:—"Judging by his continual references to 'immature forms,' Mr. Playfair seems to have rather curious ideas on the growth of Desmids. He appears to imagine that a Desmid may change its form, or develop spines or warts, at any time during its existence, losing sight of the fact that, unless dealing with monstrosities, *at least one semicell of any Desmid must be mature.* Cell-division, except under abnormal circumstances, does not take place until the two halves of a Desmid are equally developed, the newer half having arrived at maturity. Consequently, *in any Desmid in which the two semicells are exactly alike, growth has ceased and that individual is mature.* Further alteration of form, excluding the possibility of changes caused by the attacks of parasites, does not take place after the completion of the development of the new half, and spines once formed cannot become bifid or trifid, or in some other way change their nature, as Mr. Playfair appears to imagine." [The italics are Dr. West's].\*

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\* In a footnote Dr. West twits me with having mistaken a diatom for a *Closterium*, quite unconscious apparently that in "Freshwater Algae of the Third Tanganyika Expedition," (p.140, Pl.5, f.18) he has himself described and figured the same diatom, *Nitzschia reversa*, as *Ankistrodesmus nitzchioides*, sp.n.

With all deference to my distinguished critic, I cannot accept these statements in their entirety, as I believe they are in some respects erroneous. I have, indeed, quoted the remarks at length, because they so clearly and succinctly set forth the opposite of the facts of Desmid-life, as I understand it, and I maintain that the more thoroughly the latter is investigated, the more completely will the truth of this assertion be established. In the first place, in Australia, in warm weather and in shallow, stagnant waters, cell-division *does* take place a second time before the nascent semicells have become fully developed, and it is exactly this that gives rise to the multitude of degenerate forms or "species." I have already given a plain proof of this in my first paper (These Proceedings, p.197, 1907, Plates ii.-v.) from specimens all found in one locality, many years ago. On Pl v., fig.24, is shown a semicell of *Cos. venustum*, and of this species fig. 26(left figure) is a young form(*Cos. trilobulatum* Reinsch, *forma*) developing into a typical *Cos. venustum* through fig.26 (right figure). The middle figure of the three shows a mixed form of *Cos. trilobulatum*, and an immature form (*f. incognita* Playf.); while in fig.25 the latter is shown as a complete cell. In what way could fig.25 have come into existence except by division of the mixed form? — A + B, at division, becomes A + A and B + B.

Again, on Pl.xi., of the present paper, fig 7 shows a chain of eight semicells, which has come about in this way. A,A, formed the original cell, B,B, are the semicells resulting from the first division. Before these semicells are full-grown, or even disconnected, a second division has taken place in both cells (almost always in *both*, showing that it is the outcome of external influences affecting all alike) and C,C, D,D, are produced. This specimen was abstracted from a small phial containing living Desmids; before they were disturbed, fully a score of such chains could be observed, with the aid of a Coddington lens, adhering to the glass. On account of their fragile nature, such chains are not often found in gatherings, though halves are not infrequent—three immature semicells, and a more mature fourth; cf. Pl xiv., figs.9-10. In hot weather, and in shallow stagnant

waters, however, they are quite the rule of life, and are the origin of the immense number of degenerate forms connected with a species. *I*de Pl.xiv., fig.11, which is part of one end of a very long chain composed of not less than 24 semicells.

The remaining figures of Pl.xiv., satisfactorily establish this point. In a gathering of Desmids lately obtained, fig.1, *Micr. truncata* var. *decumbentata* was abundant. In the laboratory, the weather being warm, they commenced to divide rapidly. Fig.2 shows the result of the first division, but before the young semicell(b) has completed its growth, a second division has taken place, and fig.3, an entirely distinct type, has been formed. As the result of the fourth division, fig.5 is produced; and, later, I noted complete cells of the type fig.6a (practically *Micr. oscitans*). In six rapidly repeated divisions, therefore, we find three distinct degenerate types brought into existence, in addition to the original form. All these immature forms, which were present in quantity, will develop, under favourable conditions, gradually into that represented by fig.1; and this is not itself fully developed, as many specimens were observed with the lateral lobules doubling the teeth (figs.7-8), and thus passing over into the type-form, *Micr. truncata*. In the face of such evidence as this, it is surely quite clear that the word "mature" has no meaning except when applied to the fully-developed and, therefore, final form of the species.

But Dr. West might at least have accepted his own evidence. In "Variation in the *Desmidiace*" (Journ. Linn. Soc. Bot., Vol. xxxiv., Pl. x., figs. 14-15) he has himself illustrated, in the case of *Cos. Regnesii*, what he now denies can take place. He remarks (*l.c.*, p. 388), "Many stages were observed in the division of the cells, and it often happened that a second division of the cells commenced before the first was completed. This sometimes continued until several immature cells intervened between the original adult semicells." Compare, also, W. & G. S. West's Monog. Brit. Desm. (Vol. iii., Pl. lxviii., f. 25). Again, in "New and Interesting Brit. Frw. Algæ," Journ. R. Micr. Soc., 1896, Part 2, these authors have described (p. 159) and figured (Pl. iv.,

f.56) a similar same state of repeated division in the case of *St. brachiatum*. There is nothing abnormal in this kind of division. Wherever the type is to be found, the same immature form which is produced in this manner may be noted separately, sometimes in quantity, but *then* it is a new species!

Finally, in the last-mentioned paper, it is shown (Pl.iii., f.29, and Pl.iv., f.43) that newly-divided cells may conjugate and produce a zygospor. If such cells can accomplish that rare act, it cannot be believed that they are unable, under natural conditions, to manage mere vegetative division.

In the second place, so far from growth having ceased when cell-division is complete, it is only then that the development of the plant begins, continuing very slowly in the intervals of cell-division. It is because the latter bulks so largely in the life of the Desmid, that degenerate forms of the species are to be found in such abundance and variety, while the fully-developed form itself is so very rarely seen. A true Desmid-species consists of an immense number of distinct polymorphic forms which are partly successive modifications of the sporangial type under stress of rapidly repeated cell-division, partly abnormal (but in no sense monstrous) forms produced by unusual combinations of circumstances, and partly types arising from all these as the result of their struggle to develop upwards towards the perfect exemplar of the species.

That spines and processes *do* develop on the cell, has already been conclusively proved in "Some Sydney Desmids." Pl.xii., f.9, shows the well-known *St. orbiculare* with processes full-grown at the basal angles, and developing in pairs down the sides. According to Dr. West, *St. orbiculare* being mature, in the sense that both semicells are alike, cannot develop any further. But we see that it does, and I have myself observed every stage of the development.

Compare also Plate xii. of the present paper, where figs.9-14 exhibit the growth of the upper processes of *St. saxangulare*, and figs.15-18 and 20, form a series illustrative of their very gradual development (granule—spine—process), and of the resulting pro-

gression of the cell from one so-called "species" to another. The specimens of the latter series all occurred in profusion in the same gathering (No. 60, N.H.S.).

In the following notes, I have made some attempt to exemplify the real conditions of life and development among the *Desmidiaceæ*, the result of fifteen years continued observations of the same "species" from the same localities, at different times and under a variety of circumstances. This kind of study does not, indeed, cause one to become acquainted with a very large number of true Desmid-species, but on the other hand it affords excellent opportunities for gaining an insight into the life, development, and connections of such as are to be found locally. The truth turns out to be exactly what Rev. W. Archer so cautiously suggested in Quart. Journ. Micr. Sci. (New Ser., Vol. ii., 1862). "It is not proved," he says, "that some other form, which in the present state of knowledge we are constrained to suppose a distinct species, may not in truth be only a phase of variation or of development, or an 'alternation of generation' of the actual species, whose extremes of variation, or whose life-history, are as yet unknown."

The *Desmidiaceæ* are essentially plants that require to be studied *on the spot*, by comparison of the contents of repeated gatherings from the same habitat; no reliable determinations can possibly be made from the contents of isolated samples, and this is true also not only of the so-called Unicellular Algæ, but equally of the Diatoms, Peridiniæ, Flagellata, and Infusoria as well. In all these realms of life something like ninety per cent. of the "species" are polymorphic forms of the other ten; and it is only by tracing out their life-histories through the observation of transition-forms, that the specific connection of their innumerable variations can be established.

I am not aware that this aspect of the subject has received much consideration hitherto. Three short papers, however, are mentioned by Prof. O. Nordstedt in the Bibliography of his invaluable *Index Desmidiacearum*, viz.:—F. B. Carter, "Desmids, their life-history and classification," Amer. Month. Micr. Journ.,



Vol. x., No.2, Feb., 1889, and Vol. x., No.4, April, 1889. Also, A. M. Edwards, "On 'species' in the Desmidiaceæ," *ibid*, Vol. xv., 1894.\* Unfortunately I have not seen these contributions to the subject.

*Polymorphism of Doc. trabecula*(Ehr.).

There is not the slightest doubt, in my mind, that *Doc. Ehrenbergii*, *truncatum*, *crenulatum*(Roy & Bisset), *maximum*(Reinsch), *coronatum*, *Archerii*(Delp.), *Indicum*(Grun.), *baculoides*(Roy & Bisset), *nodulosum*, *phæodermum*(Schaar.), *Georgicum*(Lagerh.), *subgeorgicum*(Cushman), *manubrium*(W. & G. S. West), and even *baculum* are all growth-variations of one and the same species, which, by the accident of priority, must be called *Doc. trabecula*. This may appear a large order, but in truth these forms never should have been accorded specific rank in the first instance. A comparative study of these forms soon compels the conclusion that they are all one. According to Turner(*Alg. E. India*, p.38), Ehrenberg recognised several of them as forms of his *Doc. trabecula*; he cites Infusoria, T.vi., f.ii. Is it possible also to scan the excellent figures in Delponte(T.xix.) without admitting *Doc. nodulosum* as a variation of *Doc. trabecula*? In fig.3, *nodulosum* and *truncatum* are seen as semicells; and fig.10, which, if magnified 416 diameters, is a good illustration of *Doc. trabecula*, would at the lesser magnification be considered a form of fig.2, i.e., of *D. nodulosum*. Compare, too, the figures of *trabecula* (Pl.xxx., figs.12, 13) with those of *maximum*(Pl xxxi., figs.1,2) in W. & G. S. West's *Monog. Brit. Desm.*(Vol.i.). Fig.1 of *maximum* has even the double basal inflations which seem to be characteristic of European forms of *Ehrenbergii*; so also has the figure of *trabecula* in Pl.xxx., f.11.

\* Consult also G. S. West, "Variation in the Desmidiæ," *Journ. Linn. Soc., Bot.*, xxxiv., 1899; W. Schmidle, "Ueber die individuelle Variabilität einer Coemarienspecies," *Hedwigia*, 1898, Heft 3; O. Borge, "Ueber die Variabilität der Desmidiaceen," *Ofvers. af K. Sv. Vet.-Akad. Förh.*, 1896, No.4; and J. Lütkenmüller, "Beob. über die Chlorophyllkörper einig. Desmid." *Oesterr. botan. Zeitschrift*, xliii., 1893, No.1.

In this genus all the biological groups and variations of a species are determined by the basal diameter, not by such details as the configuration of the semicell or peculiarities of the apex, which may occur at any stage in the life-history. The clavate (*clavatum* (Ralfs)), the subclavate (*subclavatum* Wittr.), the cylindrical (*maximum* Reinsch, *baculoides* R. & B.), the excavated (*baculum*, *phaeodermum*), the undulate, etc., are not, strictly speaking, even variations, let alone species, but merely *shapes* caused by growth, which may, and to a large extent do, occur in every size of the species from lat.10 to lat.54, and probably also, but of this I have no certain knowledge, right up through the highest reaches of lat.60-85.

The character of the membrane is of no value whatever as a proof of identity. If the scrobiculation or granulation arose as the outcome of forces within the cell, they might have some weight as distinctive of variation or subspecies; but as a matter of fact, external circumstances, such as continued stagnation, are very largely, *if not altogether*, responsible for them. In sample No.109, (N.H.S.), gathered from just a few points along the edge of the swamp at Gardener's Road, Botany, upon a single occasion, there are to be found *baculum*, *baculoides*, *Ehr. f. minor*, *Ehr. type*, *Ehr. with 7-undulate base*, *Ehr. f. elongata*, *trab. v. crenulatum*, *trab. v. Farquharsonii* (Roy), all alike plainly *punctate-scrobiculate*. Any extent of scrobiculation, therefore, may be met with in cells of any age or size. Compare Pl.xi., f.3a, and Pl.xiv., f.11, where the scrobiculæ are replaced by granules in the same cell.

*Delponte's Doc. Ehrenbergii*.—The stout forms of *Doc. Ehrenbergii*—*trab. v. Delpontei* mihi, and *trab. v. constrictum* mihi, are certainly intermediate between the forms of *Ehrenbergii* proper and *trabecula v. crenulatum* (the full-grown form of *trabecula* itself). They exactly bridge the gap, both in size and character, and might indeed be equally well arranged in the *trabecula*-group. However, Delponte (Desm. subalp. p.228, T.xx., figs.1-7) and W. & G. S. West (Alg. Madag., p.45, Pl.v., f.40) have all accepted them as forms of *Ehrenbergii*; I have, therefore, included

them within that biological subspecies. As might be expected of forms linking two subspecies, the specimens of var. *Delpontei* vary a good deal in character, specially as regards the apex. The only character that can be unhesitatingly relied upon, is the breadth (basal inflation  $30-39\mu$ ). W. & G. S. West, in their Monograph, have included this variation with the smaller *Ehrenbergii*-forms. This is quite impossible with Australian specimens. *Doc. Ehrenbergii* proper here, while it has precisely the range of length and breadth given by W. West in *Frw. Alg. W. Ire.*, differs from the British forms in having only one basal inflation at all prominent (never as in Monog., Vol.i., Pl.29, figs.10-11), and the apex very often quite smooth. Our forms of *Delpontei's Ehrenbergii* either lean towards *trab. v. crenulatum* in having a plicate apex, or it has the apical granules strongly accentuated, generally in shape more like the teeth of *Doc. nodosum*, quite unlike any other form in the species.

The case of *Doc. baculum*.—At the outset I had no idea of including *baculum* in the forms of *Doc. trabecula*, in consideration of its axile chloroplast. In gathering No.109, however, it was fairly abundant in excellent condition. There was indeed a single chloroplast, but parietal and curved round the semicell into a tube, no pyrenoids at all being present. It seems certain, therefore, that the chloroplast is first axile, with a central row of pyrenoids; but, as the cell develops, the chloroplast becomes parietal, the pyrenoids are absorbed, and the centre of the cell becomes hollow. Finally, the chloroplast splits up longitudinally into three or four parietal fillets in which the pyrenoids are reformed.

The inflated form of *baculum*, which I figure (Pl.xii., f.2) had a row of decided basal granules; and accompanying it, were cells more like the typical form in Ralfs (Pl.xxxiii., f.5), and W. & G. S. West (Monog., Vol.i., Pl.27, f.1). Of these latter, some had the basal granules replaced by fainter plicæ, others had no basal markings at all, and in other cells again, one semicell would have basal plicæ and the other granules (Pl.xii., f.3). Moreover, a cell was seen (Pl.xii., f.4), *baculoides* in shape, but the breadth of

*Ehrenbergii* f. *minor*, one semicell showing distinctly the basal plicæ. The plicæ, still more faint, were also noted in a cell of var. *Ehrenbergii* (Pl.xii., f.5). These plicæ are not visible at the edge, over the margin of the cell; and it has been contended that they are of an entirely different nature from the basal granules. On the other hand, I find them occupying the same position on either side of the suture, and replacing the granules in the same cell. Neither granules nor plicæ are permanent; as the cell develops they are drawn out flat and disappear. Not only so, but the *baculum*-shape may be observed on a larger scale (Pl.xii., f.1b), with the *baculum*-chloroplast, but without either granules or plicæ. Finally, a cell has been observed (Pl.xii., f.1a) having parietal tæniæ proceeding out of an axile chloroplast. *Doc. baculum*, therefore, can be looked upon only as a young growing form of var. *Ehrenbergii*, and a variation of *Doc. trabecula*. The genus *Pleurotenium* also must be included in *Docidium*.

*Notes on, and descriptions of various forms.*

DOCIDIUM TRABECULA Ehr.

*Doc. trabecula* Ehr., cf. Næg., Gatt. einz. Alg. T.vi., f.1b.

Long. semi. 186; lat. bas. 40, centr. 36, ap. 18 $\mu$  (Pl.xi., f.1b); long. cell. 380; lat. bas. 44, centr. 37, ap. 21 $\mu$ ; Næg. *l.c.*

Auburn.

This is Nægeli's form, the dimensions being in perfect agreement. It is a younger form than that generally figured as *Doc. trabecula* (Pl.xi., f.9). A still more immature condition (*D. truncatum*) is shown joined to it (f.1a and Pl.xii., f.7). Such forms are quite common here.

DOC. TRABECULA Ehr., another form (Pl.xi., f.9).

Long. 300-335; lat. bas. 35-38; centr. 30-33; ap. 20-21 $\mu$ .

Guildford (78, 114).

In quantity (114), with var. *Delpontsi* mihi, the intermediate form. This gathering afforded another proof that incrassation, scrobiculation, and granulation of the cell-membrane are due to stagnation. It remained for a month corked up in a small phial

standing in a weak light. On examination, the living cells were found to be yellow, incrassate, strongly scrobiculate, and in some cases even granulate; whilst the cells originally dead, of which there were a considerable number, remained unaltered, with a faintly scrobiculate hyaline membrane. This breadth of *trabecula* corresponds to *truncatum* f. *gracilior* Richter.

DOC. TRABECULA Ehr., forma. (Pl.xi., f.4).

Forma parte inferiori semicellularum cylindracea; lateribus parallelis, sursum ad apices rapide convergentibus; apicibus rugis circ.12(visis 7) ornatis. Long.346; lat. bas.44; centr.40; ap.21 $\mu$ .

Guildford(78).

This is the outgrowth of var. *Farquharsonii*(Roy).

Var. FARQUHARSONII(Roy). (Pl.xi., f.5).

Long.290; lat. bas.55; centr.51; ap.24 $\mu$ .

Botany(109).

Cf. W. & G. S. West, Monog. Brit. Desm. Pl.xxix., f.6.

Var. BREKFELDII(Istvánffi), f. GRACILIOR. (Pl.xiii., f.23a).

Forma gracilior; apicibus late-rotundatis. Long. semi.67; lat. bas.30; max.38; ap.20 $\mu$ .

Auburn. Cum var. *truncato*.

Cf. Istvánffi, Felső-magyar. tozeg. megviza. T.ii., f.35.

Develops into var. *truncatum*. Compare Pl.xi., f.3, the two inner semicells.

Var. TRUNCATUM(Bréb.). (Pl.xi., f.1a, 2, 3a).

Long.170-228; lat. max.37-45; ap.18-20 $\mu$ .

Auburn(57, 67, 70, 85, 104, etc.).

When the heat causes the large forms of *Doc. trabecula* to divide repeatedly, they descend greatly in size and shape(cf. Pl. xi., f.7). These degraded forms, however, gradually pull themselves together, and var. *truncatum* is the result. It is the lowest form of *Doc. trabecula*, with the exception of var. *Brefeldii*(Istvánffi), Pl.xiii., f.23a, and allied shapes like var. *crassum* Boldt(Sibir.

Chlor. T.vi., f.44). Var. *truncatum* is the form with which the cell makes a new start in longitudinal growth.

Var. *CRENULATUM*(Roy & Bissett), non Ehr. (Pl.xi., f.13).

Forma *Doc. trabeculae* semicellulis apices versus attenuatis, rugis 14-16(visis 8-9) intra marginem apicalem instructis. Long.520-800; lat. bas 35-54; centr.32-51; ap.20-32 $\mu$ .

Ubique. (See slides 1, 7, 10, 21 for fine specimens).

Cf. Roy & Bissett, Jap. Desm., f.19. I have never, however, seen a specimen with a granulate apex. Here the apex is invariably plicate within the margin. The younger cells are attenuated from about the centre, but in more mature specimens only near the tip. This attenuate tip, with its plicae, is characteristic of this form, which is the variation of *trabecula* commonly found in this country. Lat. bas.42-45 is a general size for well-grown specimens. Roy & Bissett, *l.c.*, identify this form with *Doc. crenulatum* Ehr., but this seems doubtful, as Bailey (in Ralfs, p.219) identifies the latter with *nodulosum*. *Doc. crenulatum* Ehr., was an American form, and the figures in West(Frw. Alg. W. Ire., Pl.19, f.8-12) show that the apex of *nodulosum* (*coronatum*) may easily appear crenulate, or the undulations in the sides might have given rise to the name; whereas in Roy & Bissett's form the plications do not catch the eye even under a high magnification.

Var. *MAXIMUM*(Reinsch), forma. (Pl.xi., f.15-16).

Forma semicellulis apices versus paullo attenuatis; apicibus truncatis, rugis 14-16(visis 8-9) instructis. Long.730-875; lat bas.44-58; centr.38-45; ap.28-30 $\mu$ .

Collector, Auburn(7, 10). Cum priori rarius.

*Doc. maximum* Reinsch, is only the well-grown and strictly cylindrical form of *trabecula*, with a pronounced basal inflation. Compare W. & G. S. West, Monog., Pl.xxx., f.12, 13, with Pl.xxxi., f.1, 2. It is surely impossible to deny that these are the same plant in different stages of growth. In this country, any specimen of *trabecula* over 400 $\mu$  long is certain to have a plicate apex;

hence our forms of *Doc. maximum* differ in this respect from European cells. This variation is rare here, and the two cells figured are the nearest approach to the shape of *maximum* that I have ever seen.

The order of growth in the *trabecula*-stage of this species is, (1) var. *Brefeldii*, (2) var. *truncatum*, (3) *trabecula*, (4) var. *crenulatum*, (5) var. *maximum*—the last occasionally only.

Var. DIADEMATUM, n. var. (Pl. xi, f. 8).

Forma lateribus parallelis apices versus convergentibus; basi levissime inflata; apicibus granulis validis distinctis ornatis. Long. 494-600; lat. bas. 37-43; ap. 21-24 $\mu$ .

Collector; Coogee(1); Prospect(13); Auburn(10).

Found with var. *Ehrenbergii* and var. *crenulatum*. This form distinctly shows transition going on from the slenderer forms of var. *Ehrenbergii* and var. *Del'ponteii* to the stouter ones of *trabecula* proper, by increase in breadth from the base upwards. The upper part of these semicells belongs to the former, as the apex clearly shows; the lower half to the latter.

This coroneted apex is never found in the *trabecula*-forms proper, but is peculiar to the stout form of *Ehrenbergii* (var. *Del'ponteii* nili). The apex, though it looks so strong, is not permanent; the granules are merely rucks in the membrane, and, as the inflation of the semicell proceeds upwards, it smooths them out, producing the typical *crenulatum*-apex with faint plicæ.

Subspecies *Doc. Ehrenbergii* mihi.

I use this expression simply as a subheading to indicate a definite biological group of forms within the species. The word subspecies has formerly been embodied in the name of the Desmid. This is, however, not absolutely necessary, and complicates the nomenclature to such an extent as to be quite intolerable. It is absurd that one should have to employ a whole line of print in order to make passing reference to some particular form; and, while it is most important that the various forms should be arranged according to their natural biological connection, yet why

should it be thought necessary to embody a system of classification in the name of any organism? I have, therefore, made every distinct form a variation of the type holding priority.

Subspecies *Ehrenbergii* is only the forma *minor* or, as only breadth counts in these long forms, the forma *gracilior* of *trabecula* proper. Disregarding what may be termed infantile forms, the breadth in this group ranges from  $18\mu$  to  $37\mu$ , while in *trabecula* proper the range is from  $37\mu$  to  $76\mu$ .

DOC. TRABECULA var. EHRENBEGII (Bréb.).

Long. 264-608; lat. bas. 18-28; centr. 17-25; ap. 12-18 $\mu$ ,

Ubiquo.

The sizes include f. *minor* and var. *elongatum*. (See note, *supra*, on Delponte's *Ehrenbergii*).

Var. CONSTRICTUM, n. var. (Pl. xi., f. 11).

Forma var. *Ehrenbergii* proxima, cylindracea, apices versus levissime attenuata; lateribus parallelis; apicibus subtruncatis; supra inflatione basali valde constricta et sursum leviter excavata et inflata (ad *baculum* acc.), lateribus in excavatione undulatis. Membrana vulgo dilute serobiculata. Long. 544-606; lat. bas. 26-28; centr. 24-25; ap. 18 $\mu$ .

Prospect(43), Coogee(1).

The only differences between this form and var. *Ehrenbergii* are the decided constriction, and curious excavated appearance above the basal inflation, in which lie one or two lesser undulations. The shape is somewhat like *Doc. baculum* (compare Pl. xi., f. 14). This form is intermediate between var. *Ehrenbergii* and var. *Delpontei*; the excavated appearance is, I consider, caused by the swelling of the cell above the basal undulations preparatory to a widening of the isthmus. The base is somewhat like that of *Pl. Georgiicum* Lagerh., *Amerikas*, f. 29, but the semicell hardly at all inflated.

Var. DELPONTEI mihl. *Pl. Ehrenbergii* Delp., T. xx., f. 1-7.

Forma inter var. *Ehrenbergii* et *trabeculam* var. *crenulatum* intermedia. Semicellulæ cylindraceæ, basi levissime inflatæ et



sursum interdum inflationibus minoribus, ad apices versus leviter attenuatæ; apicibus truncatis, rugis 14-16 (visis 8-9), vel sæpe granulis 12-16 (visis 7-9), vel granulis 6 (visis 4) infra marginem ornatis. Sutura prosiliente. Membrana vulgo dilute scrobiculata. Long. 390-500; lat. bas. 30-39; centr. 28-35; ap. 20-27 $\mu$ .

Auburn(7, 10, 16, 21), Coogee(1, 4), Guildford(78, 114).

Wherever well-grown specimens of *Doc. trabecula* var. *crenulatum* are met with, the above form is sure to be found accompanying them, along with some form of var. *Ehrenbergii*. In slide 1A(N.H.S.) mounted haphazard from a pure gelatinous crust of Desmids obtained at Coogee, there may be seen, side by side, four forms exhibiting plainly the development from var. *Ehrenbergii* to var. *crenulatum*. (1) Var. *Ehrenbergii*, lat. bas. 20 $\mu$ (Pl.xi, f.10). (2) Var. *constrictum* mihi, lat. bas. 28 $\mu$ (Pl.xi, f.11). (3) Var. *Delpontei* mihi, lat. bas. 34 $\mu$ (Pl.xi, f.12). (4) Var. *crenulatum*, lat. bas. 42 $\mu$ (Pl.xi, f.13). The forms of var. *Delpontei* seem to have a strongly granulate apex more commonly than any other form in this species. Pl.xi, f.17-21 show five varieties of apex found in specimens of this variety.(*Vide* note on this variation, *supra*).

Forma **MEDIOLEVIS** (Playf.). *Pl. mediolævis*, ante, 1907, Pl.ii., f.10.

Long. 410-684; lat. bas. 30-38 $\mu$ .

Auburn.

This is merely an incrassate form of var. *Delpontei* with strongly accentuated scrobiculæ. The cells have grown to their full length, as the square apex shows; and a slight further growth has taken place at the suture. The apex in this form is exactly as figured by Delponte, T. xx., f.7. My forma *gracilior*, l.c., p.162, is only *Ehr. f. minor* in the same condition.

Forma **CONSTRICTA**, n.f. (Pl.xi., f.14).

Forma latitudine ut in var. *Delpontei*; semicellulis ut in var. *constricto* conformatis; apicibus rugis granulisve ornatis. Long. 518-750; lat. bas. 30-39; constr. 24-31; centr. 26-34; ap. 16-27 $\mu$ .

Auburn(7, 10, 21), Botany(108, 109).

## Var. OVATUM, n.var. (Pl.xi., f.6).

Forma *Doc. ovato* Nord. consimilis; semicellulis e sutura valde inflatis; lateribus ad apices rapide convergentibus; apicibus truncatis. Forma var. *Delpontei* e divisione producta. Long. semi. 95; lat. max.44; ap.21 $\mu$ .

Cooges(slide 1A).

Var. INDICUM(Grun.), non Turner, Frw. Alg. E. Ind., T.iv., f.8.

Long.624-790; lat. bas.28-36; centr 24-33; ap.22-24 $\mu$ .

Sydney water-supply(80, 81).

A plankton form of var. *Ehrenbergii*, or one caused by semi-plankton-conditions (a strong current of water). I have never met with it except in the Sydney water-supply.

## Var. BACULOIDES(Roy &amp; Bisset), forma.

Forma brevior, inflatione basali unica tantum. Endochroma in tæniis parietales 3-4 ordinata. Long.200-276; lat. bas.15-18; centr.14-15; ap.10-12 $\mu$ .

Botany(109A). Cum formis sequentibus duabus.

The semicells were the shape of Pl.xii., f.3a, but without the basal plicæ.

Var. BACULUM(Brëb.) (*Doc. baculum*). (Pl.xii., f.2, 3).

Long.178-254; lat. bas.12-15; constr 9-10; centr.13-15; ap.8-10 $\mu$ .

Botany(109A). Cum priori.

Endochroma in lamina unica sed parietali disposita. Pyrenoidibus nullis. In an empty semicell, the base of which was tilted, the basal granules were plainly to be seen. They were 16 in number, each with a plication ascending half-way up the basal inflation. It is noteworthy that there is the same number of plicæ in *Doc. manubrium*, Frw. Alg. Madag., p.44.

## Forma MAJOR, n.f. (Pl.xii., f.1b).

Forma granulis basalibus nullis vel inconspicuis; semicellulis perfecte cylindraceis, supra isthmum valde inflatis et sursum interdum levissime constrictis; apicibus aut rectis truncatisque

aut rotundatis levissime inflatis, granulis plicisve minutissimis ornatis. Endochrome in lamina unica ut videtur convoluta, ad apicem planam ordinata.

A. Long. semi.200; lat. bas.21; constrict.12; centr.14; ap.16 $\mu$ .

B. Long. semi.244; lat. bas.26; constrict.16; centr.17; ap.16 $\mu$ .

Auburn, Guildford.

A. joined with var. *Ehrenbergii*, B. with var. *Delpontei*, the endochrome of the latter specimen not noted. The semicell is the shape of var. *baculum*, but the basal granules or plicæ are wanting, and the size is larger. The interest and importance of the find lies in the fact that, whereas the endochrome of the var. *Ehrenbergii* semicell was normal, the part within the basal inflations of both semicells was evidently in the form of a parietal tubular lamina. This portion exhibited the appearance of vertical fibrils, and this slightly supports my contention that the parietal lamina of var. *baculum* divides vertically into four fillets as the cell develops into var. *Ehrenbergii*.

Var. EHRENBURGII (Bréb.), forma. (Pl.xii., f.5).

Forma ad suturam utrinque serie plicarum obscurarum (circ. 9-10 visis) ornata. Long.516; lat. bas.25; constr.21; centr.23; ap. 17 $\mu$ .

Botany(109A). Cum antecedenti.

All the forms in 109 had distinctly punctate-scribulate membranes. The three foregoing all had the same smoothly rounded but truncate apex (Pl.xii., f.8), and showed such an unmistakable similarity that there could be no doubt whatever of their specific identity. *Doc. manubrium* W. & G. S. West, Frw. Alg. Ceylon, Pl.19, f.11, and Frw. Alg. Madag., Pl.5, f.31, is simply var. *Ehrenbergii* and var. *Delpontei* in which the basal plicæ of var. *baculum* have persisted. It should stand as *Doc. trabecula* var. *manubrium*. The form here noted is practically the same, but the plicæ very faint. What difference is there between Pl.xii., f.1a, and Frw. Alg. Ceylon, Pl.19, f.11?

Var. PYGMÆUM, n.var. (Pl.xii., f 6).

Forma inflatione nulla vera, sed paullo supra basin constrictione levi; apices versus leviter attenuata; apicibus truncatis glabris; sutura prosiliente. Endochroma in tæniis disposita. Long.206; lat. bas.12; centr.12; ap.9 $\mu$ .

Botany(108).

#### COSMARICUM RECTANGULARE Grun.

A large number of well-known "species" combine to form the life-history of *Cos. rectangularæ*. All of them are mere growing forms, developing one into another under suitable conditions. There is not the slightest doubt about these identifications, as all the forms occur together, and show that peculiar likeness, under the microscope, which it is impossible to describe or put on paper. Wherever one is found, the others are sure to appear on diligent search. The species is very local round Sydney; after large and repeated gatherings, not a single one of any of the forms here mentioned has been obtained from such rich localities as Coogee, Botany, and Centennial Park. The species is entirely confined to the clay-soil district of Auburn, Guildford, Fairfield, Canley Vale, etc., where it occurs in profusion; and although there are other and permanent waters in the vicinity, yet its variations are not found except in the tiny drainage-pools and swampy patches of ground along the Southern railway line, and at Auburn. Nor have any of them been noted in the Sydney water-supply, the drainage of a large area at some distance from Sydney. As confirmatory of my conclusions about these forms, it should be remarked that many years ago at Collector, 250 miles from Sydney and 2300 feet above sea-level, I found all the principal variations associated together before.

The "species" included in this life-history are *Cos. pseudopro-tuberans* Wille(not Kirchner), and  $\beta$  *angustus* Nord., *Cos. sulcatum* Nord., *Cos. repandum* Nord., *Cos. sexangulare* Lund., *Cos. hexagonum* Elfv., *Cos. Elfvingii* Rac., and var. *saxonicum* Rac., *Cos. cyclopeum* Playf., *Cos. odontopleurum* Arch.(Roy & Bissett,

Scottish Desm., Pl.ii., f.13), (?)*Cos. flavum* Roy & Bisset, l.c. Pl.ii., f.17, and *Cos. protuberans* Lund. The last three I have not seen, but the others are certain. *Cos. flavum* must go wherever *Cos. odontopleurum* goes—the zygospores are exactly alike. The latter has already been placed as a f. *minor* of *Cos. repandum* (vide W. & G. S. West, Monog. Br. Desm., iii., 54).

The following variations of this species have been observed here:—

*COS. RECTANGULARE* var. *NODULATUM* Playf., ante, 1908, Pl.xii., f.5

Long.50-62; lat.38-44; crass.30-36; ap.17; isth.10 $\mu$ .

Auburn, Guildford(23, 45, 60). Cum forma typica.

This is, as far as I know, the final and fully-developed form. A vagueness about the apex, which seems to belie this, is probably due to the *appearance* of incrassation at the basal angle and upwards, making the upper part of the cell look weaker by contrast.

Forma MINOR. (Pl.xiii., f.5).

Long.36-38; lat.28-30; ap.14, isth.10 $\mu$ ,

Guildford(60).

Both with and without nodules. This form is almost var. *Cambrense* (Turn.) W. & G. S. West, but a little broader. The latter in same gathering.

Var. *CAMBRENSE*(Turn.) W. & G. S. West, forma.

Forma semicellulis paullo latioribus; *infra margines apicales* juxta angulos superiores nodulis singulis utrinque praeditis; lateribus angulisque plus minusve rotundatis. Long.36; lat.28; ap.14; isth.10 $\mu$ .

Guildford(60).

The nodules in this form were below the apical margin.

Var. *DENTATUM*, n.var. (Pl.xiii., f.4b).

Forma semicellulis ad var. *nodulatum* accedentibus; lateribus e basi fere parallelis; angulis basalibus dentatis. Long.50-52; lat.38; ap.20-21; isth.8-12 $\mu$ .

Guildford(89, 114).

Var. *ALTIVS*, n.var. (Pl.xiii., f.4a).

Forma semicellulis basin versus quadratis; angulis basalibus rectis; lateribus e basi parallelis sursum ad apices convergentibus; apicibus late-truncatis; angulis lateribus et superioribus levigatis. Long.60; lat.40; ap.20; isth.8 $\mu$ .

Guildford(89). Cum priori.

Var. *QUADRIGEMINATUM* Playf., *l.c.*, p.614. (Pl.xiii., f.1).

Long.45-52; lat.34-38; crass.25; ap. fronte 15-20; latere 14 $\mu$ .

Guildford(60), Fairfield(79). Cum priori rarius.

With its four nodules at the apex, this has the appearance of being a collateral type. It is, I think, certain, however, that it resolves itself into var. *nodulatum*. The form of var. *Cambrense*, supra, is practically a forma minor of this, as it must have four nodules.

Var. *NOTATUM*, n.var. (Pl.xiii., f.2).

Semicellulae altiores, magis quadratae; lateribus parallelis; apicibus leviter arcuatis; angulis inferioribus ut in *Cos. repando* Nord. notatis. Long.50-51; lat.40-42; crass.24-31 $\mu$ .

Collector.

This has the same markings under the basal angles as *Cos. repandum*; they foreshadow the accentuated angles and pointed end-view of var. *nodulatum*.

Var. *REPANDUM*(Nord.). (Pl.xiii., f.12).

Forma lateribus perfecte rectis. Long.43-50; lat.30-40; crass. 22 $\mu$ .

Collector.

*Cf.* Nord., *Frw. Alg. N. Z.*, p.58, Pl.6, f.14. This form probably develops into var. *nodulatum*; while Nordstedt's form, with hollow sides, grows into var. *dentatum* mihi.

Var. *ANGUSTIUS*(Nord.), *l.c.*, p.58, T.vi., f.15, 16.

Long.32-33; lat.24; isth.8 $\mu$ .

Collector.

According to outline, this really goes under var. *repandum*, of which it is the forma *minor*. Its sides are not so sloping as in var. *Finmarkiæ*. Var. *angustius* has the same relation to var. *repandum* that var. *cyclopeum* has to var. *Finmarkiæ*, or var. *Cambrense* to var. *notatum*.

COS. RECTANGULARE Grun., type.

Long.43; lat.33 $\mu$ .

Guildford(60), Auburn(85).

Var. *minus*(Wille), (*Cos. gotlandicum*  $\beta$  *minus* Wille, Norges Fersk., p. 31, T.I., f.13) I have not yet noted, but I think it certainly a var. of *rectangulare*. From the figures given by Wille and Wittrock, and lately by W. & G. S. West in their Monograph, it appears that the common form in Europe is depressed in the semicell, while ours are more generally subquadrate.

Var. FINMARKIÆ, n.var. (Pl.xiii., f.13).

Forma lateribus e basi plana rapide divergentibus; angulis superioribus plus minusve rotundatis; apicibus arcuatis. A vertice semicellulæ ellipticæ utrinque inflatæ. Long.38-42; lat.33-38; crass.22-27 $\mu$ .

Collector, Canley Vale(110).

Develops into var. *repandum* or var. *notulatum* by broadening of the base, the sides becoming less divergent. I had this originally down as var. *pseudoprotuberans* (Kirchner), but the forms given by Nordstedt, Desm. Grönl., T.7, f.3, and W. & G. S. West, Monog. iii., Pl.lxxii., f.6-8, certainly belong to *Cos. contractum* Kirch., as does also the *Cos. sulcatum* var. *incrassatum* W. & G. S. West, Alg. Ceyl., Pl.20, f.36-38, a form extremely common in this district. The variations of *Cos. rectangulare* (including *sulcatum*, etc.) never have an incrassate centre or an open sinus. *Cos. contractum*, *Cos. ellipsoideum*, *Cos. foveatum* Schm.(= *Cos. incrassatum* Playf., according to G. S. West), and *Cos. pseudoprotuberans* Kirch., are young forms of *Ar. Bulnheimii* Rac.,(Desm. Nowe, T.vi., f.17) of which *Xan. inchoatum* Nord., and  $\beta$  *mammillatum* Playf., are variations. These forms are all

commonly incrassate in the centre of the semicell; and never have a linear sinus, but always an open one, or, at most, one with parallel sides. Compare the *Cos. contractum* in Rac., Desm. Polon., T.x., f.10. The development of the latter also is from the top downwards; the broad truncate apex tends to remain and become broader. In Wille's *pseudoprotuberans*, (= var. *cyclopeum* Playf., forma) which is certainly a variation of *Cos. rectangulare*, the semicell develops from the base upwards, the truncate apex being continually obliterated. Wille's form is said (Monog., iii., p.70) to be a variation of *Cos. protuberans* Lund., and this I think very probable. The latter, then, must be considered a variation of *Cos. rectangulare*, a form indeed smaller than any I have yet observed, but Gutwinski has recorded the type as low down as  $28 \times 25$ . Like *Cos. protuberans* Lund., all these *rectangulare*-variations have a minutely and closely punctato-scribiculate membrane, not always so evident as in my figures, but always visible. Relying, therefore, on the evidence of Nordstedt and W. & G. S. West, I have relegated the name *pseudoprotuberans* to *Cos. contractum*. But my form in Pl.xiii., f.13, is manifestly ( $38.42 \times 33.38$ ) the f. major of Wille's specimen ( $33 \times 27$ ) and is certainly identical with the "*forma angulis superioribus semicellularum rotundatis*" of Borge, Norska Finnmark, p.12, f.10, upper semicell. I have, therefore, given it the name var. *Finnmarkiæ*.

Var. ROTUNDATUM, n.var. (Pl.xiii., f.17).

Forma var. *Finnmarkiæ* angulis superioribus valde rotundatis. Semicellulæ subreniformes; lateribus e basi plana divergentibus, minimo spatio rectis; angulis lateralibus late-rotundatis; dorso latissime et perfecte arcuato. Membrana punctato-scribiculata. Long.  $38.42$ ; lat.  $32.36$ ; crass.  $21$ ; isth.  $8\mu$ .

Guildford(114), Canley Vale(110).

This form, of whose connection there is no doubt, affords an excellent example of the smoothing down of a characteristic feature in the stress of cell-division. In the smaller forms compare var. *reniforme* and var. *subreniforme*.



Var. *HEXAGONUM*(Elf.) W. & G. S. West, forma MAJOR.  
(Pl.xiii., f.3).

Forma major, præ latitudine paullo longior. Semicellulæ magis quadratæ, lateribus longioribus; a vertice ellipticæ mediis lateribus angulatis, polis late-rotundatis. Long. 44; lat. 36; crass. 24 $\mu$ .

Guildford.

Compare Elfving, Desm. Finsk. T.i., f.8; synonym *Cos. Elfvingii* Rac., Desm. Polon., p.27.

Var. *SAXONICUM*(Rac.). (Pl.xiii., f.6).

Long. 44; lat. 40; isth. 8 $\mu$ .

Canley Vale(110).

Syn. *Cos. Elfvingii* var. *saxonicum* Rac., Desm. Nowe, T.i., f.14.

This is practically var. *Finmarkiæ* with the basal angles developed into a tooth. Many other forms occasionally show the tooth, sometimes only on one basal angle. The tooth is not permanent, but develops, as the cell grows, into the basal angle of var. *nodulatum*.

Var. *AUSTRALE*, n.var. (Pl.xiii., f.15).

Forma var. *saxonicæ*(Rac.) consimilis(sine dentibus); lateribus brevibus, leviter divergentibus; angulis basalibus acuminatis, superioribus fere rectis plus minusve rotundatis; apicibus arcuatis. Membrana minute punctato-scribiculata, interdum plicis subapicalibus binis, ternisve ornata. A vertice semicellulæ ellipticæ polis rotundatis (vel acuminatis ?) utrinque inflatione glabra, bi-, tri-cuspidata vel bi-papillata instructæ. Long. 38-42; lat. 36-38; crass. 22-25 $\mu$ .

Collector, Guildford(69).

The above bears considerable resemblance to *Cos. sulcatum* Nord.,(forma) W. & G. S. West, Alg. Madag., Pl.9, f.28; and I had, at first, the intention of making that the type-form under the name of var. *Madagascarensis*. However, the Madagascarensis form is slightly flattened above, has more pointed angles, more sloping sides below and the typical *sulcatum* end-view, in all of

which it leans to var. *sulcatum*, and is indeed the transition-form between the latter and var. *australe*.

Forma. (Pl.xiii., f.14).

Forma apicibus plus minusve acuminatis, ceteris ut supra. Long.42; lat.38; crass.24 $\mu$ .

Guildford(69). Cum priori.

This form shows the beginning of growth towards a truncate apex and subhexagonal outline.

Var. OCELLATUM, n.var. (Pl.xiii., f.16).

Forma incrassatione ad angulos laterales instructa. Pyrenoidibus singulis magnis. Long.40-42; lat.34-35; crass.20; isth.6 $\mu$ .

Guildford(89).

The peculiar appearance across the lateral angles is not a true ocellus, but apparently an incrassation. It seems to be one of the ways by which the angle is obliterated.

Var. PATERIFORME, n.var. (Pl.xiii., f.18).

Forma semicellulis subreniformibus; basi plana; angulis lateralibus late rotundatis; lateribus levissime arcuatis ad apices convergentibus; apicibus truncatis; angulis superioribus pæne levigatis. Long.40-42; lat.35-37; ap.12; isth.8 $\mu$ .

Guildford(89), Canley Vale(110).

Forma. (Pl.xiii., f.19).

Forma angulis lateralibus macula incrassata ornatis; ceteris ut supra. Long.40-44; lat.35-38; basis 30-32; ap.14; isth.8-10 $\mu$ .

Canley Vale(110), Guildford(114).

Var. SEXANGULARE(Lund.). (Pl.xiii., f.22).

Forma senilis, membrana incrassata. Long.40; lat.37; isth.8 $\mu$ . Collector.

*Cos. sexangulare* Lund., Desm. Suec. T.ii., f.23. The hexagonal form is not stable, but gradually develops into a higher form. Occasionally, however, it becomes fixed by incrassation.

Var. *SULCATUM*(Nord.). (Pl.xiii., f.21).

Long.37; lat.32; crass.18 $\mu$ .

Collector, Moura.

*Cos. sulcatum* Nord., Alg. Sandvich. T.i., f.18, 19. This is sciagraphically a variation of *sexangularis* (as is also *papillatum* mihi) with more pointed lateral angles and narrower base. Exactly the same two forms occur here in *Cos. biretum*. The dimensions given by Lundell agree perfectly with Nordstedt's highest for *Cos. sulcatum*. The sulcae are not characteristic of this variation, or indeed of any of them, being sometimes present and sometimes not, in all forms of var. *Finnmarkiae* and var. *cyclopeum* besides. In none have they any permanence, being simply a transitory device to allow for the considerable development in thickness (*crass.*) characteristic of the highest forms. In the lower forms they are often reduced to a single granule, or refractive (but not incrassate) spot, generally just below the apical margin but sometimes nearer the centre of the semicell. These hexagonal forms do not constitute a separate life-history within the species, or a distinct side-issue of it. In different sizes they alternate in development with those forms having a regularly arcuate apex. Like most other Desmids, so far from being fixed unchangeable organisms, they are merely *shapes, types of outlines* which occur over and over again with varying dimensions in different stages of the life-history of the plant. The species at its simplest is not a form, but a series of forms, through which development moves. This series, however, is, in *Cosmrium*, obscured largely by a number of degenerate forms produced by repeated division, and by a third set of forms the product of environment. In this species, however, I have noted a well-marked series in major and minor sizes. Compare *reniforme-austroreniforme-cyclopeum-subhexagonum*, with *rotundatum-patereforme-australe-nodulatum*. There may be in a species, a *forma minima*, *forma minor*, *forma major*, and *forma maxima* of the same shape, but never under any circumstances does any one of these develop directly into another—always through at least one different form.

## Var. PAPILLATUM, n.var. (Pl.xiii., f.20).

Forma var. *sulcato* consimilis, sulcis nullis, papilla autem subapicali ornata. Long.35; lat.33; basis 22; ap.12; isth.8 $\mu$ .

Canley Vale(110).

In all the(110) specimens the papilla was general and distinct, showing plainly in side-view, whether it occurred in var.*cyclopeum*, var. *subhexagonum*, var. *subreniforme*, or var. *papillatum*. This is another point that goes to show that differences in the membrane are largely due to conditions of environment affecting all alike. In other localities, the papilla is rare or only faintly expressed, the form of the cell being the same.

## Var. SUBHEXAGONUM, n.var. (Pl.xiii., f.8a, 11).

Forma semicellulis var. *cyclopeo* congruentibus, subhexagonis autem; dorso elevato, plus minusve angulato; interdum papillis subapicalibus 1-3 instructis. Long.33; lat.29; ap.10; isth.6 $\mu$ .

Guildford(114).

Found also as :—

Forma mixta 1.—var. *subhexagonum* et var. *cyclopeum*. Long.33; lat. var. *subhex*.29, var. *cycl*.27; isth.6 $\mu$ .

Forma mixta 2.—var. *subhexagonum* et var. *subreniforme*. Long.34; lat. var. *subhex*.30, var. *subren*.25; isth,5 $\mu$ .

Guildford(114).

## Var. CYCLOPEUM(Playf.), ante, 1907, Pl.v., f.12.

Granulum parvum infra apices saepissime abest. Pyrenoidibus singulis. Endochroma verticaliter divisa. Long.30-36, lat.26-32; basis 18; crass.18; isth.6-8 $\mu$ .

Collector, Guildford(114). (Pl.xiii., f.7).

This form, first found years ago at Collector, is not uncommon here along with other forms of the species. It turns out to be the same as Wille's *pseudoprotuberans* f. *minor* in Norges Fersk., Pl.i., f.18. The breadth being worked out from the figure, his dimensions are 33 x 27 x 21, isth.8 $\mu$ . It has no connection with *Cos. pseudoprotuberans* Kirchner.

## Var. SUBRENIFORME, n.var. (Pl.xiii, f.9).

Forma e var. *cyclopeo*, angulis lateralibus basalibusque confluentibus producta. Semicellulæ subtriangulares; apicibus angustis subtruncatis; angulis basalibus latissime rotundatis; lateribus sursum leniter deplanatis, ad apices rapide convergentibus; apicibus infra marginem interdum papilla instructis. A vertice ellipticæ, utrinque leviter inflatæ, polis obtusis. Pyrenoidibus singulis. Endochroma verticaliter divisa. Long.30-35; lat.23-30; crass.15; ap.8-12; isth.5-6 $\mu$ .

Canley Vale(110), Guildford(114).

The basal angles of this form are always broadly rounded, never sharp as in *Cos. nitidulum* De Notar., and *Cos. galeritum* Nord. Var. *subreniforme* and var. *reniforme* are produced from var. *cyclopeum* by repeated division.

Forma mixta—var. *cyclopeum* et var. *subreniforme*. Long.30; lat. var. *cycl* 28, var. *subren.*25; isth.6 $\mu$ .

Guildford(114).

## Var. RENIFORME, n.var. (Pl.xiii, f.10a).

Forma e. *subreniformi* producta, dorso depresso. Semicellulæ depressæ, pæne reniformes; dorso leniter arcuato. Membrana minute punctato-scribiculata.

Found as yet only as mixed forms:—

Forma mixta 1.—var. *reniforme* et var. *subreniforme*. Long. 33; lat. *renif.* 29, *subrenif.* 29, ap.10; isth.6 $\mu$ .

Fairfield(116).

Forma mixta 2.—var. *reniforme* et var. *cyclopeum*, f. Long. 27; lat. *renif.* 25, *cycl.* 23; isth.5 $\mu$ .

Guildford(114).

The latter is practically identical with the mixed form figured by Borge, Alg. v. Schweden, T.2, f.26; the size also is the same. It has already been connected with *Cos. rectangulare* by W. & G. S. West, Monog., p.56.

I had at first intended arranging all these variations in three sections or subspecies, viz.:—(1) lower sides parallel, (2) lower

sides divergent, (3) semicells hexagonal. Simple and reasonable as this classification looks, when only a few forms are known, it is entirely artificial and broke down at once as soon as proper research was made into the life of the species. First, a large number of forms appeared, both in quantity and as *formæ mixtæ*, which had *rounded* outlines and yet were too closely connected with more typical forms to be separated from them and classed by themselves. Secondly, I discovered that between the extremes of the type, on the one hand, and var. *sexangulare* on the other, there might be found every degree of slope in the lower sides. This goes far to prove the connection of them all in one species.

ST. MONTICULOSUM Bréb., and ST. FORFICULATUM Lund.

When a small isolated pool or patch of swampy ground is selected, and the Desmids it contains subjected to close and systematic investigation extending over several years, two things may be expected. Firstly, we may be simply overwhelmed with polymorphic forms, all plainly connected together in life and growth (among which will probably be many well-known "species"), and all anastomosing together, through transition-forms, into a perfect maze. Secondly, a series of forms may be obtained, showing every stage in the development of any given Desmid; and, by patient search, the difference between any two terms of the series may be made as small as desired.

There might be some justification for the theory that a certain similarity in outline is merely the record of evolutionary relationship, provided we were able to retain a reasonable gap between the forms. But when two such evolutionary relations become connected by a series of forms exhibiting no greater difference among themselves than may be found in the figures of a kinematograph film, we are justified in considering that it is the record of one continuous action. Such a series is figured in Pl.xii., f.15-20.

The following are the specifications of the various forms:—

ST. ORBICULARE var. MUTICUM (Bréb.). (Pl.xii., f.15).

Long.30; lat.24; isth.8 $\mu$ .

Guildford(60).

The semicells become a little more adpressed in the next form, which develops out of this—hence the cells are a little shorter.

Var. GRANULOSUM, n.var. (Pl.xii, f.16).

Forma semicellulis subreniformibus, sinu angusto introrsum rotundato constricta; angulis lateralibus interdum aculeo minuto præditis; apicibus interdum levissime deplanatis; lateribus denticulationibus minutissimis 3-5 instructis. A vertice semicellulæ triangulares; lateribus concavis; angulis inflatis acuminatis aculeo minuto munitis; medio granulis 6 concentrice ordinatis et mediis angulis binis. Membrana minute punctato-scribiculata. Long. 27-28; lat.24-30; ap.8-10; isth.8-10 $\mu$ .

Guildford(60).

This form is found sometimes with four denticulations and a spine (or five without) on each side, developing through var. *aculeatum* into the *forficulatum*-form; and sometimes with three denticulations and a spine (or four without) growing directly into var. *bisarium* forma.

Var. ACULEATUM, n.var. (Pl.xii., f.17).

Forma sinu angusto non lineari constricta. Semicellulæ subtriangulares, plus minusve adpressæ; apicibus minime deplanatis; angulis lateralibus in processum bifidum brevissimum productis; lateribus levissime convexis, aculeis brevibus geminatis binis superne instructis et interdum denticulationibus supra processum. A vertice semicellulæ triangulares, interdum angulis inflatis lateribus concavis, interdum angulis planis lateribus pæne aut perfecte rectis; apicibus angulorum constrictis, in processum cylindraceum brevissimum productis. Membrana punctato-scribiculata. Long. c.ac. 34, s.ac. 30-32; lat. c.proc. 32, s.proc. 28-30; long. spin.circ. 2; ap. 10; isth. 8-10 $\mu$ .

Guildford(60).

The end-view is at first with inflated angles and hollow sides, as in *St. orbiculare*; but develops into one with flat sides. At this stage, the end-view much resembles that of *St. submonticu-*

*lozum* Roy & Bisset (Jap. Desm., f.7); which is another variant of this species.

Var. *BIFARIUM*(Nord.) forma. (Pl.xii., f.18).

Forma angulis lateralibus in processum brevem productis; processibus(spiniive) sublateralibus inter angulos et apicem superne positis. Membrana punctato-scribiculata. Long. c.proc. 25-38, s.proc. 25-30; lat. c.proc.30-36, s.proc.24-26; ap.12-14; isth.10-12 $\mu$ .

Guildford(60).

Specimens of long.25-28 $\mu$ , are those in which the apical processes are very short, hardly projecting above the apex. The processes, which in Nordstedt's form are on a level with the lateral angles, are here situated higher up, projecting above the sides in front view; but as the semicell develops, they grow out more and more horizontally, and descend gradually to the level of the lateral processes.

*St. Tohopekaligenae* Wolle,(cf. W. & G. S. West, Frw. Alg. Ceyl., p.181, Pl.21, f.27) is a more fully developed form of var. *bifarium*. The shape of the body is that of *St. orbiculare* var. *muticum*, and the size exact(36 x 27, isth.9.5). There is, of course, no specific characteristic in the length of the processes—it stands to reason that they grow longer; nor is the number of spines of any value; it is just as easy for a third and fourth to develop as it was for the first two.

Var. *FORFICULATUM*(Lund.) forma. (Pl.xii., f.20).

Forma minor, verrucis basalibus et processibus utrinque ad angulos deficientibus. Membrana punctato-scribiculata. Long. c.proc. 34, s.proc. 30-32; lat. c.proc. 36, s.proc. 28-30; ap. 14; isth. 10-16 $\mu$ .

Guildford(60, 114).

Var. *forficulatum* is a collateral variation with var. *bifarium* in this line of development. In the latter the apical processes develop at the expense of the others, while in the former it is the lateral processes that do so, the others being reduced (for the time) to mere bifid verrucæ. Lundell's end-view does not seem



to be quite accurate. There are three pairs of processes down each side; there should be three, therefore, (besides the sublateral ones) in end-view. The two denticulations at the apex of his figure are the tips of the two apical verrucæ at the head of the foreshortened angle.

A mixed form of the above and var. *bifarium* forma was noted.

Var. *AGGERATUM* (Playf.), *ante*, 1907, Pl. iv., f. 21.

Long. 28; lat. s.sp. 30 $\mu$ .

Botany.

Both front and end-views are quite correct. Var. *aggeratum* is a young form of var. *forficulatum*, and develops into it through var. *aculeatum*.

Forma. (Pl. xii., f. 19b).

Forma lateribus apicibusque magis rotundatis, glabris; apicibus quam levissime deplanatis; angulis lateralibus interdum aculeo interdum nullo præditis.

Common round Sydney. This form, like var. *granulosum*, is common to both the *bifarium* and *forficulatum* lines of development. Dimensions noted as yet only in:—

Forma mixta.—var. *bifarium* f. et var. *aggeratum* f., Pl. xii., f. 19. Long. c.proc. 35, s.proc. 32; lat. var. *bifar.* c.proc. 38, s.proc. 26; lat. var. *agger.* c.sp. 34, s.sp. 28 $\mu$ .

Guildford(60).

ST. SEXANGULARE (Bulnh.) Rabenh.

Descriptions of variations illustrating the development of processes.

ST. SEXANGULARE var. *STELLINUM* (Turn.).

Synonyms, *St. stellinum* Turn., Alg. E. Ind., Pl. 15, f. 6; *St. sexangulare* f. 5-radiata immatura Playf., *ante* 1907, p. 185, Pl. v., f. 11. Lat. c.proc. 75-120 $\mu$ .

Collector.

The processes become shorter and stouter as the denticulations form,

*Forma mixta*.—var. *stellinum* et var. *gemmescens* (infra).  
Long. c.proc. 34, s.proc. 32; lat. *stell.* 98, lat. *gemmesc.* 72 $\mu$ .  
Collector.

Var. *PLATYCERUM* (Josh.). (Pl.xii., f.9).

Long. 30; lat. corp. 16, c.proc. 76; isth. 10 $\mu$ .

Sydney Water-supply.

A six-rayed form; only an optical section is given of all the forms. Compare Joshua, Burm. Desm., Pl.24, f.2. Whatever the author intended fig.1 to be, it can be accepted only as the end-view of a four-rayed form. Cf. Borge, Austral. süßw., T.2, f.23.

Var. *DENTATUM*, n.var. (Pl.xii., f.10).

*Forma dentibus triangulis singulis vel aculeis validis singulis in vicem processuum superiorum instructa*. Long. centr. 30-40; lat. corp. 17-18, c.proc. 64-76; isth. 10; long. spin. ad 12 $\mu$ .

Sydney Water-supply. Cum priori rarius.

Fig.10a shows the spine from another specimen, indicating a second mode of development. Granules form on either side of the spine, and as these grow outwards into spines the upper part of the original falls in and is drawn out flat.

Var. *GEMMESCENS*, n.var. (Pl.xii., f.11).

*Forma processibus superioribus brevissimis, glabris, bifidis; apicibus cellularum interdum productis truncatis*. Long. centr. 36; lat. c.proc. 80 $\mu$ .

Collector.

Var. *SUBGLABRUM* W. & G. S. West, forma. (Pl.xii., f.12).

*Forma processibus superioribus perfecte glabris, vel denticulationibus singulis utrinque munitis*. Long. centr. 60; lat. c.proc. 100 $\mu$ .

Collector.

Var. *ASPERUM*, n.var. (Pl.xii., f.13).

*Forma denticulationibus processuum pæne in aculeos protractis; processibus leviter inflatis*. Long. centr. 60; lat. c.proc. 105 $\mu$ .

Centennial Park. Rarissime.

## PEN. SPIROSTRIOLATUM Barker. (Pl.xiii, f.24).

Long. 210; lat. 18; ap. 10 $\mu$ .

Botany(109).

A cell with costæ more spiral than any I have seen before. The specimen shows very well the development of the membrane. The new growth perfectly hyaline and unstriate, the older portion rufescent and costate.

## CL. ROSTRATUM Ehr. (Pl.xiii, f.25).

Forma cum endochroma 6-radiata; vesiculis terminalibus distinctis granulosa circ. 7 continentibus. Membrana corporis rufescente, striis nullis. Long.293; long.corp.152; lat.18; ap.3,4 $\mu$ .

Potts Hill(113).

The beak of the lower semicell approximates to that of *Cl. Kützingerii*. This species is a most serious example of the way in which obvious and striking characteristics have been ignored hitherto in the diagnosis of the species, and minute differences, which can often with difficulty be recognised, have been elevated into fundamental specific characters. *Cl. Kützingerii*, *Cl. setaceum*, *Cl. pronum* Bréb., and *elegans* Bréb., are all merely growth-variations of *Cl. rostratum* as the nomenclatural type. In this connection it should be noted that W. & G. S. West, in their Monograph, have failed to recognise *Cl. pronum* Bréb. Brébisson in his "Liste," pp.156-157, uses the same words to describe the beak of *Cl. pronum* as of *Cl. setaceum*, viz.:—"prolongement filiforme diaphane," the apex "obtus et même un peu renflé." *Cl. pronum*, which is not uncommon round Sydney along with *Cl. Kützingerii*, has a body about one-half the length of the cell, much longer proportionately than in *Cl. setaceum*, and about 8 $\mu$  broad. Sometimes the body is fusiform and evenly attenuated, but sometimes flat on one side (more or less) and inflated on the other. The latter is Brébisson's form, and gives rise to his remark:—"Ce *Closterium* ressemble au *Cl. gracile*." The membrane is generally slightly rufescent and faintly striate, the striæ always with difficulty detected. *Cl. elegans* Bréb., in my judgment, is a

young form of *Cl. pronum* in which the setaceous beak is not quite formed, the tip acute. Cleve's figure, *Sveriges sötvattnens- alg.*, f.8., shows both these forms together, the lower semicell *pronus*, the upper *elegans*. The range of dimensions noted in Australian specimens was:—Long. 159-400; lat. 7-11; ap. circ.  $2\mu$ ; with broader specimens of lat. 13-18 intermingled. The latter verged on *Cl. setuceum*, but the body proportionately longer, and still the tendency in the inflation to be towards the inner side. Brébisson's figures work out at about:—Long. 454-483; lat. 9-13 $\mu$ . Raciborski, *Desm. Ciast.*, p.10, Pl.i., f.40, gives—Long. 314; lat. 8; ap.  $2\mu$ —membrana luteola, subtiliter striata. Compare the remarks by Bornard, *Protococc. et Desm.*, p.64, and his figure Pl.i., f.54.

TRIP. GRACILE VAR. SUPERBUM (Maskell) Nord., forma.

(Pl.xiii., f.26).

Long.semi.c.sp. 290, centr. 278; lat.bns.c.sp. 60, s.sp. 38 $\mu$ .

Botany(2a).

This specimen I noticed lately in the same sample that yielded *Trip. serratum* Playf. (ante 1907, Pl.ii., f.2). By comparing it with the latter, the development of the teeth may be observed. From the back of each tooth, a second grows out, the two together forming a bifid verruca (cf. var. *ornatum* Borge, *Austral. alg. sw.*, T.4, f.56). The latter may become still more elaborate by growth of additional verrucæ; note the three basal verticils in my figure. In a note, *i.e.*, p.163, on *Trip. serratum*, I remarked that such a form might develop either into var. *superbum* (Mask.) or into var. *bidentatum* Nord. As a matter of fact it does both. Here we have an example of the former; and lately I noticed a cell of this kind with the teeth of *Cl. serratum* but drawn out at the tips into aculei in length equal to one-half the diameter of the cell, *i.e.*, nearly twice as long as those in Nordstedt's form. All forms of *Triploceras* are growth-variations of one species, viz., *Trip. gracile* Bailey, 1851, *e.g.* var. *verticillatum* Bail., 1848, var. *aculeatum* Nord., var. *bidentatum* Nord., var. *superbum* Mask., var. *occidentale* Turn., var. *bilobatum* Turn.,

var. *serratum* Playf., and var. *denticulatum*(Playf.) G. S. West.  
Why not apply this same rule to the other genera?

DOC. TRABECULA var. DELPONTEI mihi, formæ. (Pl.xi., f.7).

Long. semicell. per ordinem deorsum 210, 133, 133, 162, 180,  
162, 140, 310 $\mu$ .

Slide 110A.

The lengths of the semicells A,A, viz., 210 $\mu$  and 310 $\mu$  respectively, show that the original cell was not complete when the first division took place.

## EXPLANATION OF PLATES XI.-XIV.

### Plate xi.

Fig.1.—*Doc. trabecula* Ehr.(b) + var. *truncatum* (Bréb.)(a) ( $\times 232$ ).

Fig.2.— „ var. *truncatum*(Bréb.) ( $\times 232$ ).

Fig.3.—The same dividing ( $\times 232$ ).

Fig.4.—*Doc. trabecula*—form with square base—outgrowth of fig.5 ( $\times 347$ ).

Fig.5.— „ var. *Farquharsonii*(Roy) ( $\times 347$ ).

Fig.6.— „ var. *oratum*, n.var. ( $\times 347$ ).

Fig.7.— „ var. *Delpontei* mihi ( $\times 116$ ). An example of double division, a phenomenon which is very common but not very often seen, as the chain of cells necessarily breaks up very easily. A,A, the original semicells; B,B, the semicells formed at the first division; C,C, and D,D, semicells formed at the second division.

Fig.8.—*Doc. trabecula* var. *diaulematum*, n.var. ( $\times 232$ ).

Fig.9.—*Doc. trabecula* more advanced in growth ( $\times 347$ ).

Fig.10.— „ var. *Ehrenbergii*(Bréb.) ( $\times 347$ ).

Fig.11.— „ var. *constrictum*, n.var. ( $\times 347$ ).

Fig.12.— „ var. *Delpontei* mihi ( $\times 347$ ).

Fig.13.— „ var. *crenulatum*(Roy & Bissett) ( $\times 347$ ).

Figs.10-13 are four forms found side by side in a mount made from a single mucilaginous growth of desmids. They serve to show the development of var. *Ehrenbergii* into var. *crenulatum*.

Fig.14.—*Doc. trabecula* var. *Delpontei* f. *constricta*, n.f. ( $\times 347$ ).

Figs.15-16.—*Doc. trabecula* var. *maximum* Reinsch, Australian forms ( $\times 232$ ).

Figs.17-21.—Various forms of apex in *Doc. trabecula* var. *Delpontei* mihi ( $\times 463$ ).

## Plate xii.

- Fig. 1.—*Doc. trabecula* var. *Ehrenbergii* (Bréb.) (a) + a baculum-shaped semicell (b) (lat. bas. 21) showing that the chloroplast alters from an incomplete tube in var. *baculum* to parietal fillets in var. *Ehrenbergii* as the cell develops. The lower portion of the endochrome is still undivided in (a), and the apical part in (b) shows the original axillary lamina. *Pleurotonium* is only the adult form of *Doridium*. ( $\times 347$ ).
- Fig. 2.—*Doc. trabecula* var. *baculum* (Bréb.) showing the tubular parietal chloroplast ( $\times 463$ ).
- Fig. 3.—*Doc. trabecula* var. *baculum* (b) + a younger form in which the basal granules are replaced by fainter plicæ not visible beyond the margin. There is thus no essential difference between the granules and the plicæ ( $\times 463$ ).
- Fig. 4.—*Doc. trabecula* var. *baculoides* (Roy & Bissett), forma ( $\times 347$ ). A curious form, uniting the shape of var. *baculoides*, the basal plicæ of var. *baculum* and the size (lat. bas. 18) and apical granules of var. *Ehrenbergii*.
- Fig. 5.—*Doc. trabecula* var. *Ehrenbergii* (Bréb.), forma ( $\times 347$ ). Basal portion only, to show the faint plicæ discernible on either side of the isthmus.
- Fig. 6.—*Doc. trabecula* var. *pygmaeum*, n. var. ( $\times 463$ ).
- Fig. 7.—*Doc. trabecula* (b) + var. *truncatum*, a living specimen, showing the "cellular" arrangement of the protoplasm ( $\times 347$ ).
- Fig. 8.—Apex of forms of *D. trabecula*, viz., var. *Ehrenbergii*, var. *baculum*, and var. *pygmaeum*, all found together in one gathering (No. 109). The cell-wall of all these was strongly punctato-scribulate, as shown; at the ends the pores could plainly be seen running through the inerassate membrane ( $\times 463$ ).
- Fig. 9.—*St. sexangulare* Buinh., var. *platycerum* (Josh.) ( $\times 463$ ).
- Fig. 10.—,, var. *dentatum*, n. var. ( $\times 463$ ).
- Fig. 11.—,, var. *gemmescens*, n. var. ( $\times 463$ ).
- Fig. 12.—,, var. *subglabrum* W. & G. S. West, forma ( $\times 463$ ).
- Fig. 13.—,, var. *asperum*, n. var. ( $\times 463$ ).
- Fig. 14.—,, type ( $\times 463$ ).
- Figs. 9-14 show the development of the upper processes in *St. sexangulare*.
- Fig. 15.—*St. orbiculare* var. *muticum* (Bréb.) ( $\times 695$ ).
- Fig. 16.—,, var. *granulosum*, n. var. (a) end ( $\times 695$ ).
- Fig. 17.—,, var. *aculeatum*, n. var. (a) end ( $\times 695$ ).
- Fig. 18.—,, var. *bifarium* (Nord.) f. (a) end ( $\times 695$ ).
- Fig. 19.—*St. orb.* var. *bifarium* f., (a) + var. *aggaratum* Playf., forma (b), ( $\times 463$ ).
- Fig. 20.—*St. orb.* var. *forficulatum* (Lund.), forma ( $\times 695$ ).

Figs. 15-20 show the growth of the processes in *St. monticulosum* Bréb., and *St. forficulatum* Lund., and the development of these desmids out of *St. orbiculare* var. *muticum* (Bréb.) All the forms were found in the same gathering (60) in quantity, except fig. 20.

Fig. 21.—*Doc. trabecula* var. *crenulatum*, showing reticulate incrassation ( $\times 463$ ).

Plate xiii.

Fig. 1.—*Cos. rectangulare* var. *quadrigeminatum* Playf., (a) side ( $\times 463$ ).

Fig. 2.— „ var. *notatum*, n. var. (a) side ( $\times 463$ ).

Fig. 3.— „ var. *hexagonum* (Elf.) W. & G. S. West (a) end ( $\times 463$ ).

Fig. 4.—*Cos. rect.* var. *altius* (a) n. var. + var. *dentatum* (b) n. var. ( $\times 463$ ).

Fig. 5.— „ var. *nodulatum* Playf., f. *minor*, n. f. ( $\times 695$ ).

Fig. 6.— „ var. *saxonicum* (Rac.) ( $\times 463$ ).

Fig. 7.— „ var. *cyclopeum* (Playf.) ( $\times 695$ ).

Fig. 8.— „ var. *subhexagonum*, n. var. (a) + var. *cyclopeum* (b) ( $\times 695$ ).

Fig. 9.— „ var. *subreniforme*, n. var. (a) end ( $\times 695$ ).

Fig. 10.— „ var. *reniforme* (a) n. var. + var. *cyclopeum* (b) ( $\times 695$ ).

Fig. 11.—*Cos. rectangulare* var. *subhexagonum* forma ( $\times 695$ ).

Fig. 12.— „ var. *repandum* (Nord.), f. ( $\times 463$ ).

Fig. 13.— „ var. *Finnmarkiae*, n. var. ( $\times 463$ ).

Figs. 14-15.— „ var. *australe*, n. var. ( $\times 463$ ).

Fig. 16.— „ var. *ocellatum*, n. var. ( $\times 463$ ).

Fig. 17.— „ var. *rotundatum*, n. var. ( $\times 695$ ).

Fig. 18.— „ var. *patereforme*, n. var. ( $\times 695$ ).

Fig. 19.— „ „ forma ( $\times 695$ ).

Fig. 20.— „ var. *papillatum*, n. var. ( $\times 695$ ).

Fig. 21.— „ var. *sulcatum* (Nord.) ( $\times 695$ ).

Fig. 22.— „ var. *sexangulare* (Lund.) f. *senilis* ( $\times 463$ ).

Fig. 23.—*Doc. trabecula* var. *Brefeldii* (Istv.) (a) + var. *truncatum* (b) ( $\times 463$ ).

Fig. 24.—*Pen. spirostriolatum* Barker, forma ( $\times 463$ ).

Fig. 25.—*Cl. rostratum* Ehr., (a) + var. *Kützingerii* (Bréb.) Klebs (b) ( $\times 463$ ).

Fig. 26.—*Trip. gracile* var. *superbum* (Maskell) Nord., forma ( $\times 232$ ).

Plate xiv.

Figs. 1-10.—Degeneration in type produced by continuous cell-division due to rise in temperature. The forms are not described or named, as they came about under more or less artificial conditions. (Figs. 7-8  $\times 347$ . The rest  $\times 463$ ).

Fig. 1.—*Micr. truncata* var. *decemdentata* (Näg.), the original cells.

Figs. 2-4.—Results of first, second, and third divisions respectively.

Fig. 5.—Result of fourth division. Figs. 5, 4b and 6b resemble *Micr. incisa* Bréb., cf. Turn., Alg. E. Ind., T. vi., f. 7, 8.

- Fig.6.—Result of fifth division; 6a is practically *Micr. oscitans* Ralfs, f. *minor*.
- Figs.7-8.—Lateral lobules of *Micr. truncata* var. *decemdentata* developing into the type by growth of additional spines and cleavage of lobules.
- Figs.9-10.—Examples of continuous division, halves of 4-celled chains (six immature semicells with a more mature semicell at each end); (9) in *Ar. triangularis*; (10) in *Micr. truncata* var. *decemdentata*.
- Fig.11.—Part of a very long chain of degenerate cells of *Docidium trabecula* produced by continuous division. The cell A+B has divided a second time before B has completed its previous division, being not yet cut off by a septum. The chloroplasts were continuous through three semicells. All these four cells were alive, and joined into a chain, as marked.



# THE ORE-DEPOSITS OF BORAH CREEK, NEW ENGLAND DISTRICT, N. S. W.

By LEO A. COTTON, B.A., B.Sc., LINNEAN MACLEAY FELLOW OF  
THE SOCIETY IN GEOLOGY.

(Plates xv.-xvi.)

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## INTRODUCTION.

In June and July, 1909, it was my good fortune to visit the Conrad Stannite Mine at Borah Creek. The Manager, Mr. L. Judell, made my stay a very pleasant one, and afforded me every facility for investigating the mine throughout the greater part of the workings. Unfortunately mining operations were suspended at the time of my visit; and though the water was being kept out of the main drive, the bottom level was still under water and could not be examined. It is my desire to record here my great appreciation of Mr. Judell's kindness and help in assisting me to an understanding of the mine and its workings.

[The mine was again visited in May, 1910. It was then under the management of Mr. Beasley, to whom, as well as to Mr. J. F. Stephen, I am indebted for the information obtained during this second visit.]

The Conrad Stannite Mine is situated on Borah Creek, at Howell, about 18 miles south by west from Inverell. It may be

reached from the latter town either by the Inverell-Copeton Road, or by a turn-off from the Inverell-Bundara Road. The country in the immediate vicinity of Howell presents some very interesting physiographic features. The New England Plateau is here worn to the level of the Stannifer\* peneplain, above which residuals of an older peneplain about 400 feet higher are visible. This plateau is intersected by the Gwydir River, of which Borah Creek is a tributary.

The country-rock is one of the "acid granites,"† and is of a reddish colour on account of the abundant pink orthoclase crystals present. Comparatively large areas, several acres in extent, of smooth bare granite relieve the forest-greens by their brick-red colour. This is specially noticeable on the northern slopes of the hill facing the town. The Borah Creek Lode has proved of less hardness than the "acid granite," and its consequent more rapid rate of erosion has determined the position of the creek, which follows the outcrop in a most marked manner (see text-fig.1). The lode has been intersected by one conspicuous fault which has thrown it, and has also left its mark upon the topography. Where the fault crosses the lode in Borah Creek, a small tributary is developed on each side along the line of the fault-plane (see text-figs.1-2).

#### GEOLOGY.

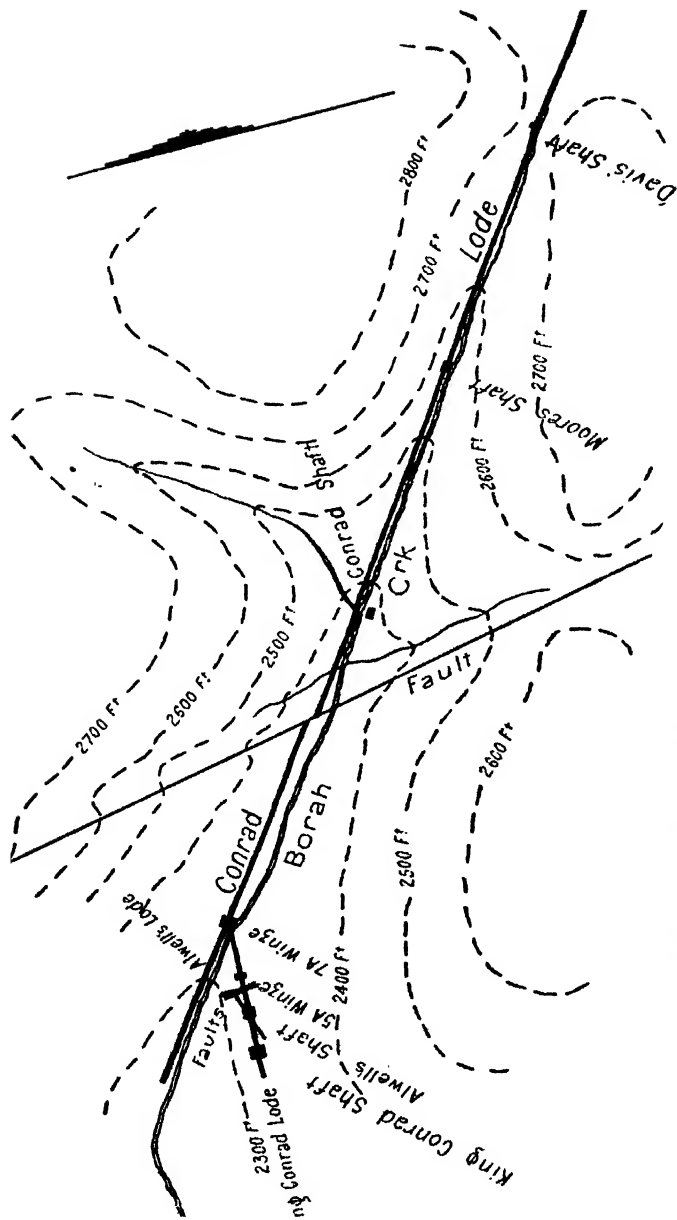
The geological formations of the district consist of three units, slates, granites, and basalts.

The slates are the oldest series, and are probably of Silurian age. They are everywhere much altered by the intrusions of the later granites. The nearest occurrence of these rocks to the mine is a comparatively small patch, situated about 2 miles to the north by east from Howell.

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\* Andrews, E. C., "The Geology of the New England Plateau. Part I., Physiography." Records Geol. Survey N.S.Wales, Vol.vii., pp.281, 1904.

† *Ibid.*, Parts II. and III., with special reference to the granites of Northern New England.



Text-fig. 1.—Plan of Borah Creek silver lodes, illustrating relations of the lodes to Borah Creek, and also the influence of the main fault on the physiography, as indicated by the sketch-contours.

*The basalts* are the youngest formations, and, like the clay-stones, do not occur closer than a mile or thereabouts to the mine. Even at this distance there is no great development of basalt, the occurrence being of the nature of cappings to Tertiary leads. The basalts themselves have been clearly demonstrated to belong to the Tertiary period.

It is with *the granites* that the ore-deposits are concerned; and of these granites there are two main types. The most important in this discussion is the "acid granite," previously mentioned; and the other has been designated, by me, the Tingha Granite. The latter is certainly the older rock, and has been intruded by the "acid granite." It is a hornblende-biotite granite, with large porphyritic crystals of plagioclase felspar. The "acid granite" consists almost entirely of quartz and felspar in its type development. Various phases of it contain small proportions of biotite, and tourmaline is occasionally present. Micrographic intergrowth of quartz and felspar is a very characteristic feature.

A small part of the generalised map of the district (see text-fig.3) given in a former paper\* is reproduced to show the approximate relationships of the geological units in the vicinity of the mine. The boundaries here have not been traversed, and are only crude approximations; yet they are sufficiently accurate for the purposes of this discussion.

#### ORE-DEPOSITS.

It will be seen, by reference to the map, that the ore-deposit at Borah Creek occurs in a tongue of "acid granite," at no great distance from the contact formed by its intrusion into the Tingha Granite; indeed the south-eastern portion of the ore-deposit crosses the junction of the granites. The lode, though readily traceable on the surface for over two miles, has, for such a permanent ore-body, quite an insignificant outcrop. Towards its north-western limit the main lode is joined by another, known

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\* Cotton, Leo A., "The Tin-Deposits of New England, N.S.W. Part I. The Elsmore-Tingha District." Proc. Linn. Soc. N.S. Wales, 1909, p.733.

as the King Conrad Lode. The main lode has now been prospected for more than a mile in length, and the ore-values have proved fairly uniform over that distance. Shoots of ore do occur, but these will be considered later. The main drive in the mine is at the 400-foot level from the King Conrad shaft, and this is connected right through to the Conrad shaft, about half a mile to the south-west. Several shafts have been sunk on the lode, and these may be seen by reference to text-fig. 2. As the lode outcrops on the summit of the hill, about 400 feet above the King Conrad Mine; and as the deepest level is the 550 feet drive from the bottom of Moore's shaft, the vertical extent of the ore-body has been proved for about 1000 feet.

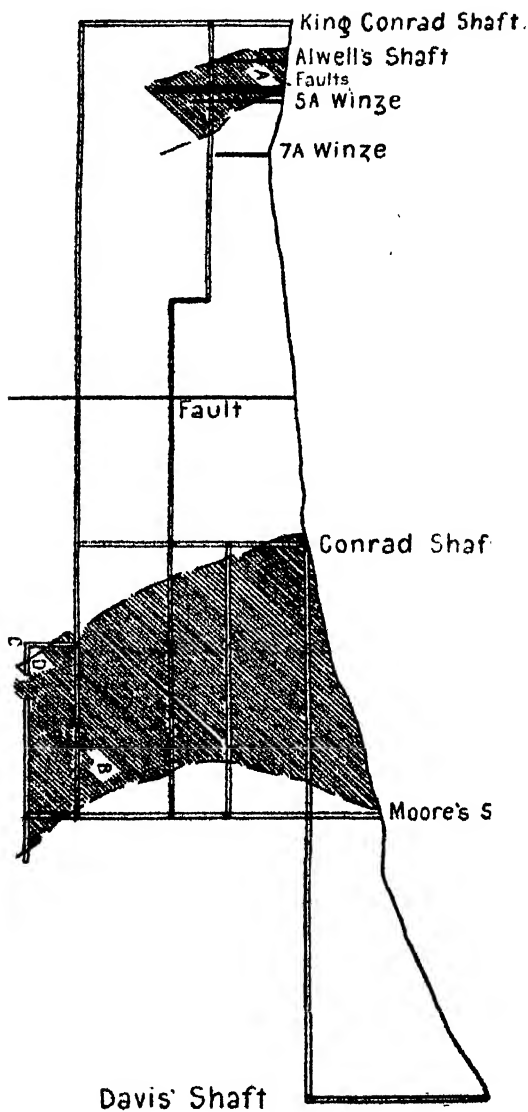
The chief minerals present are quartz, galena, sphalerite, arsenopyrite, pyrite, chalcopyrite, and stannite. The combination of these makes the ore a very refractory one; and the metallurgical problem has, so far, been the stumbling block in the development of the mine.

*The fracture system* of the district is worthy of some consideration, as it enables the relative age of the ore-body to be determined. Observations of joint-systems show that the following directions of jointing are represented within two miles of the mine. The bearings are given in degrees, measured clockwise from north, which is taken as the zero-position.

25°, 43°, 92°, 103°, and 355°.

A comparison of these directions with those prevalent in the Elmore-Tingha tin-bearing area,\* some 10 miles to the east, shows that they may all be grouped in the representative systems of that district. The bearing of the King Conrad Lode is 98°, and that of Alwell's lode is 85°. These both correspond to known fracture-systems of the area just mentioned. The main Conrad Lode, however, bears 125°, and does not correspond to any of the important systems of fracture above referred to. This lode, moreover, is thrown by a fault bearing N.15°W., which direction has no representative in the Elmore-Tingha District.

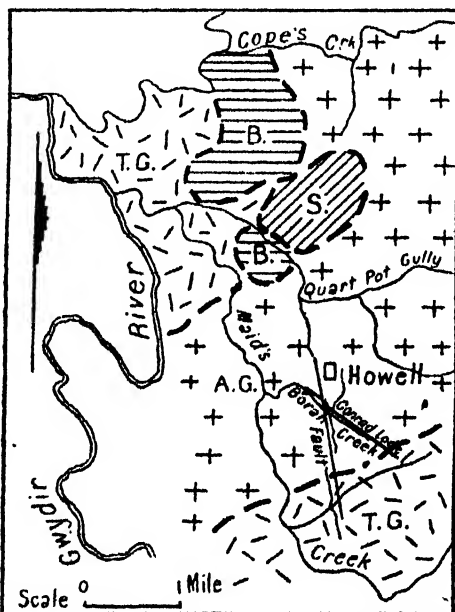
\* Cotton, *loc. cit.*, p.752.



Text-fig. 2.—Section of the Borah Creek silver-lodes, showing the positions of the two chief ore-shoots by the shaded areas.

At A, metasomatic replacement of galena by quartz.—At B, metasomatic replacement of quartz by sphalerite.—At C, winze connecting 400 and 550 ft. levels.—At D, ascending waters met with in drive.

From this it would appear, that the main Conrad Lode and the large fault which intersects it, are younger than the Elmore-Tingha system of fractures; for it is difficult to imagine how such a large and permanent fissure could have escaped alteration during the epoch of formation of cassiterite veins. The fault referred to is, in the main, due to horizontal strain. The fault-



Text-fig. 3.—Illustrating the relation of the lodes to the geology of the district.

T.G., Tingha Granite—A.G., Acid Granite—  
B., Basalt—S., Slate.

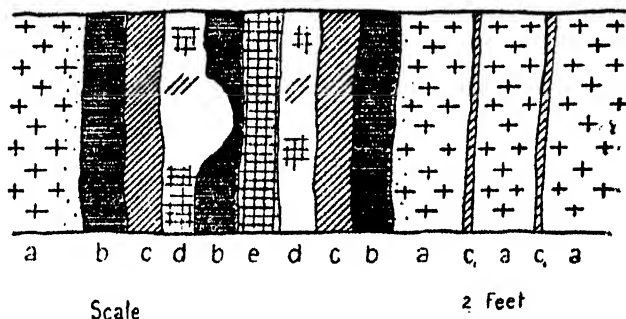
plane is nearly vertical, having slightly to the west; and the horizontal displacement of the lode, which is itself practically vertical, amounts to about 15 feet. It is probable that the fissure was formed to relieve the strain due to the final stages in the cooling of the granite-stock.

## THE LODES.

*The King Conrad Lode* has been mentioned as a fissure joining the main Conrad Lode from the south-west side. The main shaft was sunk on the north side of the lode to a depth of 400 feet, and the lode was then worked by a main drive from this level, which was carried on to the Conrad Lode. There was no indication that the King Conrad Lode crossed the Conrad Lode, and work has not been carried on beyond the latter ore-body. Another level has been driven at 150 feet, and most of the good ore has now been stoped above this level. The lode is narrow, varying from about 9 inches up to 3 feet in thickness; the average width is about 18 inches. The lode-material consists of quartz, pyrite, arsenopyrite, argentiferous galena, sphalerite, chalcopyrite, and stannite. The last of these was not observed in any portion of the lode visited by me, but the Manager informs me that its presence is revealed by analyses. The fissure is a clean break, and the lode is exceptionally free from brecciated masses in the lode-material. Near its junction with the Conrad Lode there is, however, a large lens of granite at the 400-foot level. The lode abuts sharply against the granite-walls, which have not been impregnated with mineral to any extent. There is no soft casing or "dig" to the lode, but the ore-body is "frozen" to the walls. An excellent section of the lode at the 150-foot level was sketched from a fresh fracture (see text-fig.4). The ore-body here consisted of a solid mineral mass about 2 feet wide, and a couple of small veins each about an inch wide, running parallel to the main mass. The three outer layers of mineral are symmetrically disposed on each side of the lode, while the two central bands destroy the symmetry of the whole. Arsenopyrite, as a solid crystalline mass, occupies the outermost zone; next comes a band of sphalerite and chalcopyrite; and the third zone is a band of milk-white, crystallised quartz, which towards its outer margin, is intergrown with argentiferous galena. The central portion of the vein is filled by two bands of mineral, one of arsenopyrite and the other of argentiferous galena.



A noticeable feature of the lode is that there is practically no zone of oxidation, the sulphides being found right at the surface. What little oxidised ore does exist, occurs on the slope of the hill near Moore's and Davis' shafts, and extends only to a depth of 30 feet. A very interesting example of metasomatic replacement of galena by quartz is to be seen in one of the upper stopes. Here the crystallised galena can be traced gradually into pure quartz. The quartz has retained the cleavages of galena to perfection. Samples of the latter, in thin seams between flat sheets



Text-fig. 4.—Section of King Conrad Lode, illustrating sequence of the ore-deposition.

a, granite slightly altered next the lode—b, arsenopyrite—c, sphalerite and chalcopyrite—d, quartz intergrown with argenterous galena and sphalerite—e, argenterous galena—c<sub>1</sub> small banded veins, chiefly sphalerite and galena.

#### THE CONRAD LODGE.

of quartz, may be observed where the replacement is not quite complete. The replacement has been effected by surface-waters. It is worthy of note that this metasomatic action has taken place in the main ore-shoot of the King Conrad Lode. A glance at text-fig. 2 shows the position (marked A) with reference to the ore-shoot, which may be seen as an irregularly shaped mass pitching easterly.

The Conrad Lode is undoubtedly the main ore-body; it persists for considerably more than a mile in length, and has been

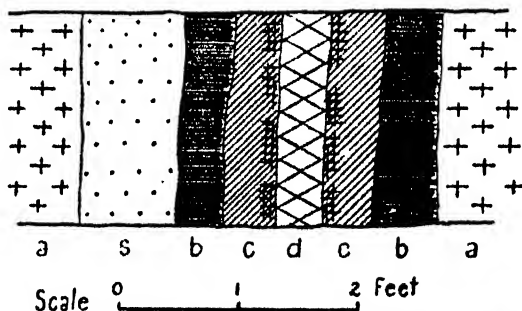
prospected for over 6000 feet along the line of outcrop. The latest figures show that the mine has been worked continuously for more than 4000 feet along the lode. North of its junction with the King Conrad Lode the outcrop is not so well marked, but two prospecting shafts sunk along the line of lode have both shown ore-values. The lode has been mainly worked between the King Conrad and the Conrad Shafts. These shafts have been connected, at the 400-foot level, by a long drive along the ore-body, and much of the ore has been stoped from this level, practically, and in some cases actually, to the surface. From the ground-level, at the Conrad Shaft, an adit has been driven into the "Big Hill" for about 2000 feet; this is connected with the surface by Moore's Shaft. The mouth of this latter shaft is some 300 feet above that of the Conrad Shaft. The accompanying section (text fig. 2) illustrates the positions of the shafts referred to.

The Conrad Lode, like the King Conrad, has a well defined ore-shoot, pitching to the south-east at a steep angle. This is represented by the shaded area in the figure. A very prominent feature of this lode, in which it differs from the King Conrad, is the presence of a conspicuous soft casing or "dig," as it is termed. This occurs sometimes on one, and sometimes on the other side of the fissure. It is always intermediate in position to the lode and the country-rock. It varies from 2 to 9 inches in width, and is of a clayey nature, with abundant quartz-grains similar to those in the granite. The junction of this clay-selvage with the granite-wall is frequently marked by slickensides; and the striae are vertical in some cases, and horizontal in others. The presence of this soft band is of great economic importance, as it enables mining to be carried on at a minimum cost.

As far as the mineralogical structure of the lode is concerned, it resembles that of the King Conrad. The constituent minerals are the same, consisting of arsenopyrite, pyrite, galena, sphalerite, chalcopyrite, stannite, and quartz. In this lode the stannite, though more abundant than in the King Conrad Lode, is yet only present in small quantity—the tin-content averaging about 0.5 %

of the ore. The silver-values for average ore are higher than in the King Conrad Lode. The silver is probably associated with galena, (possibly as sulphide of silver) but assays show that, of the metalliferous minerals, arsenopyrite and sphalerite also contain appreciable quantities. It was also noticed that, where the galena is associated with sericite, the silver-values are higher; and it is possible that the sericite itself contains silver.

Text-fig. 5 is a section of the lode, which is symmetrically banded, and shows the same order of deposition as was noted in the King Conrad Lode. This lode, too, is rather wider than the



Text-fig. 5.—Illustrating the banding of the Conrad Lode.

a, granite—s, soft band of kaolinised rock, the "dig"—b, arsenopyrite—c, sphalerite and chalcopyrite merging into sphalerite and galena—d, comb-quartz.

King Conrad, its average width being about 2 feet. This section differs from that of the King Conrad Lode chiefly in the existence of a pronounced "dig," which has been described. The outer bands are of arsenopyrite, and these are followed by admixed sphalerite and chalcopyrite, which pass over into a zone of mixed sphalerite and argentiferous galena. The central portion of the vein is filled with quartz exhibiting well marked comb-structure. It was difficult to select a specimen of sufficiently large size to illustrate the nature of the banding, but Plate xvi., gives a fair representation of portion of the lode. It

is worthy of note that the widest portions of the lode are usually the richest.

The shoot previously mentioned, and represented in text-fig. 2, is wider than the normal vein. The latest developmental work in the mine was carried out in prospecting this shoot. Moore's shaft was sunk 150 feet below the main drive, and a winze (marked C in text-fig. 2) was put down to the same level, from a spot some distance north, in the main drive. From the bottom of each of these, drives were started to connect with one another. A very interesting and important phenomenon was observed in the drive from the bottom of the winze. After driving for a short distance, it was found that water was entering the drive underfoot. A further examination revealed the fact that the water was proceeding from the clay-selvage. After this, the drive was observed to become hot and stuffy, as well as being continually wet. Unfortunately the temperature of this rising water was not recorded, but the Manager is of the opinion that it was appreciably warm, and that the heat was due to this cause. The foul air was probably due to gases emanating from the water. The amount of water entering the drive was estimated at about 4,000 gallons per day. This drive was under water at the time of my visit. The drive from Moore's shaft did not meet with any such phenomena, and remained cool and fresh throughout.

Another interesting feature in this part of the mine is the abundant replacement of crystallised quartz by zinc-blende. This process has been most active at the spot marked B in text-fig. 2. It will be seen that this is close to the place where the water was observed entering the mine from underfoot. The significance of this will be pointed out later.

Three phases in the replacement are well marked :—

The first consists of masses of crystallised quartz in which an occasional crystal of quartz has been partially or wholly replaced by zinc-blende. In this phase, the crystals adjoining the replaced crystal are unaffected by the process (Plate xv. fig. 2, A).

The second consists of masses of crystallised quartz, in which many of the crystals have been attacked—some wholly, and others partially replaced by zinc-blende. About one-half of the original material has been attacked in this phase (Plate xv., fig. 2, B).

The third consists of masses of zinc-blende, most, if not all, of which has replaced the crystallised quartz. There still remain, strangely enough, odd crystals of quartz which have quite preserved their integrity, though completely surrounded by zinc-blende (Plate xv., fig. 2, C).

These facts have suggested to me that, in metasomatic changes, the molecular structure of the crystals plays a very important part. It would appear that a complete crystal may preserve its integrity even where a wholesale metasomatic change is taking place, and yet, as in the first phase, another crystal may entirely break down in the midst of a resisting body of crystals. This has suggested, further, that if, by some means, a portion of a complete crystal be destroyed, the remaining part is in a state of unstable equilibrium, and is thus much more readily attacked than a complete crystal. This might be explained by supposing that each molecule is less strongly attached to the crystal by the attractive forces of its fellow-molecules on a fractured surface, than when in a complete crystal. This may also explain the readiness with which metasomatic processes, in general, operate along cracks in various minerals, as sericite after quartz, etc.

Galena was also found crystallised in the quartz in juxtaposition to the metasomatic zinc-blende, but no definite evidence could be obtained to indicate that it was a metasomatic product. It is probable, however, that such is the case.

At various places throughout the mine, numerous vughs occur. These are lined with large quartz-crystals projecting inwards towards the centre of the cavities. The vughs vary in size from a few inches to several feet in diameter; and are generally bean-shaped, and have their long axes vertical. It is worthy of note that these cavities frequently contain hydrous iron-oxides.

An occurrence which is quite rare in the mine, is the presence of molybdenite. A small piece of that mineral, about the size of a shilling, was found on the north side of the Conrad Lode, at its junction with the King Conrad Lode. There is no evidence of cassiterite or allied minerals in connection with this discovery. Small pieces of molybdenite were also found in the adit-level, and in the 100-foot level, at the Conrad Shaft. The wall-rock bounding the Conrad Lode has not been altered to any great extent. It has been impregnated for a few inches, chiefly with arsenical pyrites and sericite, but the change is not very marked.

#### THE GENESIS OF THE DEPOSITS.

It has been shown that, though the bearing of the King Conrad Lode corresponds to a well marked fissure-system in the Tingha area, some ten miles to the east, yet that of the Conrad Lode is quite unique in direction. It is well established that the tin-deposits are due to the ascent of heated vapours and liquids along lines of fracture; and hence, had the Conrad fissure been in existence at the time of the formation of the tin-bearing veins, it is inconceivable that it could have escaped alteration by the tin-bearing solutions. Hence it is fair to assume that this important fissure is younger than the tin-veins.

Again, it is probable that the King Conrad fissure was initiated contemporaneously with the corresponding set of fractures in the Tingha area, but that it remained closed until crossed by the heavier Conrad fissure, for it would appear that both lodes have been formed simultaneously. It has been mentioned that the Conrad Lode lies at the margin of a large tin-bearing district, and this must not be overlooked in considering the origin of the deposits.

The occurrence of cassiterite in association with metallic sulphides is by no means uncommon. In a previous paper,\* I have mentioned several instances; and these I would here recapitulate, in order to trace a connection between tin-veins proper and silver-lead veins.

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\**Loc. cit.*

There occur in the Tingha District—

- A.(1) Tin-veins proper—with no metallic sulphides.
- (2) Tin-molybdenite veins.
- (3) Tin-arsenopyrite veins.
- B.(4) Tin-copper-arsenopyrite veins.
- (5) Tin-copper-galena veins.
- C.(6) Tin-silver-galena-zinblend-copper-arsenopyrite veins.

These six types fall into three groups—

- A.Tin as oxide in association with oxides.
- B.Tin as oxide in association with sulphides.
- C.Tin as sulphide (stannite) in association with sulphides.

Thus a complete gradation can be traced from tin-veins proper to lead-veins in this district. This, then, indicates a common origin for both types of veins. In this connection it is interesting to compare the Conrad Mine with other silver-lead mines in different parts of the world.

Professor Vogt\* has written an interesting summary on this point which reads as follows:—"For the older as well as the younger ones [mineral veins], we may declare that a clear genetic connection with eruptive rocks can be established. In some eruptive districts the latest eruptives of the series exposed are even later than the ore-veins; hence the formation of the latter must have occurred during the eruptive epoch."

"Partly for this reason, and partly because of the fact that, on the whole, the veins are generally independent of the petrographic nature of the country-rock, I think we are warranted, in this department also, in assuming, as a working-hypothesis, that the ore-material was extracted from a magma. With regard to the younger veins especially, we must keep in mind a possible extraction from a laccolitic magma in depth."

"In support of this hypothesis, we may cite the transitional, or intermediate occurrences between the cassiterite- and the silver-lead-veins. Thus, in Cornwall, the tin-, tin copper- and

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\* Vogt, J. H. L., "Problems in the Geology of Ore-Deposits." Trans. Amer. Inst. Min. Eng., Pospney Vol.1901, pp.656-7.

the galena-veins are so closely related topographically and geologically that a common origin must be assumed for them. The same is true of the cassiterite veins and the various silver-lead-ore-formations of the *Erzgebirge*; and the peculiar tin-bearing silver-lead veins of Bolivia may be recalled in this connection."

"These intermediate groups warrant the conclusion that there can have been no absolute essential difference between the genesis of the cassiterite and that of the silver-lead-veins. If the tin-veins are to be explained by magmatic extraction, the silver-lead veins may not be attributable to the work of underground water."

Again, Spurr,\* in considering the sequence of ore-deposition, has summarised his views as follows:—

"In an earlier paper† setting forth a theory of ore-deposition it was proposed by the writer that the most important class of ore-deposits (save of the most common metals) were differentiation-products resulting from the siliceous extreme of the differentiation of rock-magmas; that the successive steps of this metal-depositing stage of the differentiation followed one another in a normal regular order, and were deposited in successive zones, according to temperature. It was also pointed out that, with the downward progress of the cooling of the parent magma (and the consequent sinking of the isogeotherms), the successive zones of mineralization would migrate downward, and successive cementations of successive openings at a single horizon would show the superposition of one zone upon another originally distinctly lower."

"A preliminary attempt was also made to define some of the principal zones as follows:—

"1. The pegmatite zone, containing tin, molybdenum, tungsten, etc., with characteristic gangue minerals, such as tourmaline topaz, muscovite, beryl, etc.

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\* Spurr, J. E., "Ore-Deposition at Aspen, Colorado." *Econ. Geol.* Vol. 14., No. 4, June, 1909, p. 318.

† *Econ. Geol.* Vol. ii., No. 8, December, 1907, pp. 781-795.



"2. The free gold-auriferous pyrite zone, with coarse quartz gangue.

"3. The cupriferous pyrite zone.

"4. The galena-blende (galena usually argentiferous) zone.

"5. The zone of silver and also much gold, usually associated with metals which combine with them to make substances which are undoubtedly highly mobile, and account for the relatively elevated position of the zone. These associated metals include antimony, bismuth, arsenic, tellurium, and selenium. Characteristic minerals of this zone are tellurides, argentiferous tetrahedrite and tennantite, polybasite, stephanite, and argentite.

"6. The zone of earthy gangues, barren of valuable metals."

Here we see that the order which he ascribes to ore-formation from magmatic differentiation is, (1) tin and allied ores, (2) free gold-auriferous pyrite zone, (3) cupriferous pyrite zone, (4) galena-blende zone.

In connection with the Borah Creek Mine, it has been shown—

1. The Mine is situated in the same country-rock (the "acid granite") as the adjacent tin-deposits.

2. Arsenopyrite is the earliest deposited mineral in the lode.

3. This is followed by a sphalerite-chalcopyrite zone.

4. And further by a galena-zone (argentiferous).

5. And finally by a quartz-filling.

The order of deposition in the Borah Creek Mine, and its association with the tin-deposits, is thus strikingly in accord with the generalised order suggested by Mr. Spurr.

The arguments in favour of the formation of the Borah Creek Lode from a deep-seated, magmatic extraction are briefly as follows :—

1. The relationship of the deposits to the adjacent tin-deposits—a complete gradation existing between the two types. This relationship is not unique, but occurs in other parts of the world.

2. The absence of ore in the joints adjacent to the lode is evidence against the lateral secretion theory.

3. The compact nature of the country-rock is also against the lateral secretion theory.

4. The great length (more than a mile), and the great uniformity in both length and breadth, are not favourable to the lateral secretion theory.

5. The presence of ascending warm water is in favour of a deep-seated origin.

6. The presence of stannite, which could not have been formed from meteoric waters by any known chemical reactions.

#### SEQUENCE OF PROCESSES INVOLVED IN THE FORMATION OF THE ORE-BODY.

The following is put forth as an explanation of the Borah Creek ore-deposits.

In or about Permian times, the shales in this portion of New England were intruded, first by a biotite granite, and later by the "acid granite." As this last intrusion solidified, it cooled from above downwards, thus forcing the unsolidified portions of the magma—largely silico-aqueous solutions of minerals—to a greater depth in the earth's crust. The contraction of the mass, consequent in cooling, gave rise to strains which were relieved by systems of fracture, more or less constant in direction, along which the aqueous mineral-bearing solutions were able to rise.

It has been pointed out that there were two eras of fracture at Borah Creek, one contemporaneous with the fractures of the Tingham tin-district, and the other postdating the formation of these ore-deposits. The earlier fracture remained closed until the development of the later one. The later fissure is, by far, the more important, and its formation was attended by the development of a crushed zone along the line of fissure. Solutions arising along this crushed zone, attacked the feldspars, and effected complete kaolinisation. Following this kaolinisation, further movement occurred, giving rise to slickensides on the walls of the crushed zone. The movement was predominantly vertical in some parts, and horizontal in other parts of the mine. Next came the opening of the fissure, which gave a more ready access to the solutions. In the course of this opening, the crushed zone adhered, for the most part, either to one wall or

the other, but occasionally divided, and adhered, in part, to both walls. This opened the way for the deposition of the ores. Previously the solutions arising along the crushed zone were slow-moving, and chilled rapidly with ascent, thus losing, at the same time, their solvent power. With an open fissure, however, the ascending solutions could maintain a relatively high temperature, and so carry the metallic substances towards the surface. When the temperature fell, the most insoluble minerals, under the conditions of solution, were naturally the first to precipitate.

Change in the nature of the solution, due to minerals precipitated from it and access of new solution, doubtless complicates the problem, but several well marked phases of deposition may, nevertheless, be distinguished. Arsenopyrite is found forming as the outside zone, and is, consequently, the earliest deposited mineral. It is, as a rule, fairly well marked-off from the sphalerite band, which lies adjacent to it on either side of the lode. In many places, a good deal of pyrite is associated with the arsenopyrite, and seems to be partly later, and partly of contemporaneous origin. Following the deposition of sphalerite, came the formation of admixed copper pyrites and sphalerite. Accompanying this phase of the deposition, stannite is to be found in the vein. This mineral does not usually occur as a distinct band or vein,\* but in bunches of irregular shape and size, situated between the zone of sphalerite and the inner metallic zone, which is galena. The last deposition filled the centre of the fissure with comb-quartz.

The presence of numerous vugs in the mine, with their linings of quartz-crystals, and occasional fillings of hydrous iron-oxides, suggests the following explanation. As the fissure became filled by deposition from solution, some irregularity in the filling might well be conceived; and, hence, the possibility of certain spaces being cut off from the main body of solution, may be readily admitted. Given an isolated body of solution, crystallisation

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\* In one place stannite was observed as a very distinct band in the lode. In this case, it occupied a position between the arsenopyrite and sphalerite bands.

would proceed, with fall of temperature; and, according to the observed order in the fissure-filling, quartz should be the last constituent to crystallise; and this is found to be the case in the vughs.

Though the order given above is typical of the mine in general, it frequently happens that one of the zones of mineral is repeated in the series, *e.g.*, the arsenopyrite band in the centre(text-fig.4). Again, quartz is always more or less present throughout the whole width of the vein-stuff, being intergrown with all of the minerals occurring in the mine. The irregularity in deposition of the metalliferous zones may be ascribed to a pulsating movement in the solution, so that a solution which has already deposited, say, a layer of zinc-blende, may, by decrease in pressure, be caused to sink in the fissure, and become diffused in the bulk of the solution; thus, when the fissure was again charged with solution, arsenopyrite would probably be again deposited, and the cycle of deposition be re-established. A diagram has been drawn to indicate the relative order of crystallisation(text-fig.7).

After the complete filling of the lode, further earth-movements resulted in fractures trending about N.15°W., and S.15°E. These have intersected both the King Conrad Lode and the Conrad Lode(text-fig.1). The faults intersecting the King Conrad are due to minor movements, but that throwing the Conrad Lode is on a larger scale. No deposition has taken place along any of the fault-planes.

#### CORRELATION WITH OTHER OCCURRENCES.

Mr. Spurr, in examining the ore-deposits of Monte Cristo, has tabulated some very interesting observations on the order of deposition of the ores in that district. He points out that, in this mine, metasomatic changes have been so great that, except in local crustified portions of the lode, it is difficult to make out the sequence of crystallisation. In the Conrad Mine, on the other hand, the lode is typically well banded, and the problem is comparatively easy of solution. As has been pointed out, metasomatic action has not played an important part in the Conrad Lode, being represented only by changes in the lode-material, and

slight alteration of the walls of the lode. In his examination of the ore deposits of Monte Cristo,\* Mr. Spurr has given an ideal diagram of the sequence of the ores in this district. This is here reproduced (text fig. 6), slightly modified, for comparison with the order observed in the Borah Creek Mine. A corresponding diagram (text fig. 7) has been drawn for the sequence of ore-deposition in the Borah Creek Lodes. There is a very striking similarity between the structure of the two ore-bodies.

Text-fig. 6.—Modification of Mr. J. E. Spurr's diagram illustrating sequence of ore-deposition at Monte Cristo, Washington.

B, Beginning of crystallisation—E, End of crystallisation—1, quartz—2, arsenopyrite—3, pyrite—4, chalcopyrite—5, pyrrhotite—6, blende—7, galena—8, realgar—9, stibnite—10, calcite.

#### SUMMARY.

The Borah Creek Mine is situated in the New England District of New South Wales, within two miles of the Gwydir River. The lode is a solid granite, of a very acid nature, which has intruded an older and more basic granite. The "acid granite," as Mr. Andrews has termed it, has been shown by several writers to be intimately related to the tin-deposits occurring along its margin. The Borah Creek Lode crosses the contact

Text-fig. 7. — Diagram illustrating sequence of ore-deposition at Borah Creek.

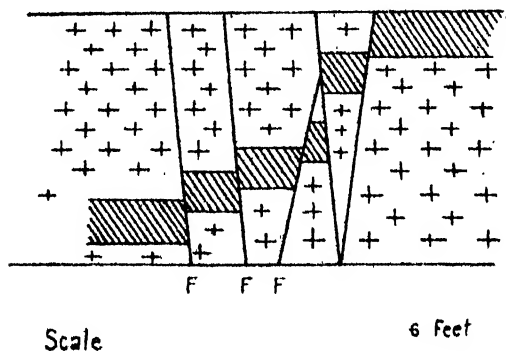
B, Beginning of crystallisation—E, End of crystallisation—1, arsenopyrite—2, pyrite—3, chalcopyrite—4, sphalerite—5, stannite—6, galena—7, quartz.

\* Spurr, J. E., "Ore-deposits of Monte Cristo, Washington, Twenty-Second Annual Report U.S. Geol. Surv., Pt. II., Ore-deposits, p. 840.

of the "acid granite" with the older granite, but lies mainly within the former. The age of this "acid granite" has been estimated as Permian.

The ore-deposits occupy two fractures, one trending  $E.5^{\circ}N.$ , and the other, and more prominent, trending  $E.35^{\circ}S.$  The former lode is parallel to a well developed series of fractures in the tin-bearing district some ten miles further east; the latter has no representative system of fractures in the district. It is inferred that the Borah Creek deposits are of a younger age than the tin-deposits, for, had such a fracture as the Conrad Lode existed at the time when these were formed, the active processes accompanying their formation would assuredly have affected the fracture.

A series of faults bearing about  $N.15^{\circ}W.$  have intersected both lodes. A pretty example of the minor faulting in the King Conrad Lode is represented in text-fig.8. The only important fault is that intersecting the Conrad Lode. This fault has



Text-fig. 8.—Diagram illustrating faulting in the King Conrad lode. F, fault.

determined the position of several small streams. One of these stream-courses may be noted in text-fig.1, on which the sketch-contours indicate how the fault has influenced the physiography. This may also be seen in Plate xv., fig.1.

The proximity of the lodes to the tin-lodes and their occurrence in the same rock, suggest some relationship. A complete series of types of lodes has been made out, between the tin-veins proper and the complex ore-bodies of the Borah Creek Lodes. The ores contained in the mine are arsenopyrite, zinc-blende, chalcopyrite, stannite, and galena. The ores are the same in both lodes, but rather more stannite is present in the Conrad than in the King Conrad Lode. In the Conrad Lode the clay-selvsage is present, sometimes on one side, sometimes on the other, and occasionally on both sides of the lode. This does not occur in the King Conrad Lode. The ores are very uniformly distributed through the mine, both along the lode and in depth. There is practically no oxidised zone and the sulphide ore outcrops in the bed of Borah Creek, the direction of which has been determined by the lode. There are two fairly well defined shoots in the mine, a small one occurring in the King Conrad Lode, and a larger one in the Conrad Lode. These are shown by the shaded areas in text-fig.2.

The order of deposition of the minerals, which form symmetrical zones in the fissure, is arsenopyrite, stannite, pyrite, zinc-blende, chalcopyrite, galena, and finally quartz. This normal order is frequently disturbed by the reopening of the fissure, and also by the rejuvenescence of the depositing solution. The deposit is a very typical, banded fissure-lode, and very little metasomatic replacement occurs, though it was carefully sought for. The country-rock has been feebly altered for a few inches from the lode, the replacing constituents being chiefly arsenopyrite and sericite. Two well-marked examples of replacement of the vein-material were observed. At A in text-fig.2, the galena forming one of the zones in the lode has been replaced by quartz, which has retained to perfection the cleavages of the original mineral. This change has been effected by surface-waters. At B, in the same figure, beautiful examples of replacement of quartz by zinc-blende are abundant. This change has probably been effected by rejuvenated, ascending solutions. In the bottom drive of the mine, at the spot marked D, warm

ascending waters were observed to enter the drive from the clay-selvage. This phenomenon is probably the last phase in the deposition of the ores.

Comparison with other occurrences indicates the probability of a genetic relationship between the silver-lead deposits and the tin-deposits. The tin-deposits of Cornwall, Germany, and Bolivia have been thought to be closely related to the silver-lead deposits in proximity to them. Again, Mr. Spurr has proposed a magmatic extraction theory for ore-deposition, which is strongly supported by the evidence of the sequence of deposition contained in this paper. It is suggested that the Borah Creek deposits have been formed later than the tin-deposits, by deposition from highly aqueous and siliceous magmatic extractions containing relatively large amounts of metallic sulphides.

#### CONCLUSION.

In conclusion, it may be said that the genesis of the ore-deposits indicates—

(1) Permanence of the ore-body at much greater depth than the limits of mining can attain.

(2) A gradual increase, with depth, in arsenical pyrites, zinc-blende, and possibly stannite, though, from the uniformity of the lode, as already known, this probably takes place so gradually as not to affect very appreciably the economic value of the deposits.

(3) The probable permanence of the shoot in which the ascending waters were discovered in the Conrad Lode.

It is not too much to hope that, in the near future, the metallurgical difficulties in dealing with so complex an ore may be solved, and that this mine will take rank amongst the most valuable of this State's mineral assets.

#### EXPLANATION OF PLATES XV.-XVI.

##### Plate xv.

**Fig.1.**—Photo. of Borah Creek, showing how the line of lode corresponds with the Creek; and also showing the effect of the large faults upon the topography.



LLL, line of lode : FFF, line of fault—M, Moore's Shaft—D, Davis's Shaft—C, Conrad Shaft—7, winze—5, winze—A, Alwell's Shaft.

Fig. 2. —Three specimens illustrating extent of the metasomatic replacement of quartz by sphalerite.

A, massive quartz with one hexagonal crystal, replaced by sphalerite—B, more advanced stage of metasomatic replacement—C, stage of almost complete replacement; only a few quartz crystals unattacked.

(Two-thirds nat. size.)

Plate xvi.

Portion of Conrad Lode illustrating banding.

A, pyrite and chalcopyrite with quartz—B, sphalerite, with quartz-veins—C, galena—D, quartz.

(Two-sevenths nat. size.)

[Printed off September 15th, 1910].

WEDNESDAY, AUGUST 31st, 1910.

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The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, August 31st, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

MESSES. ARTHUR LARCHIN BUTLER, Sandy Bay, Hobart, Tas., and FRANK DEBENHAM, B.A., Sydney, were elected Ordinary Members of the Society.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 9 Vols., 67 Parts or Nos., 13 Bulletins, 4 Reports, 22 Pamphlets, and one Map, received from 59 Societies, &c., and 2 Individuals, were laid upon the table.

## NOTES AND EXHIBITS.

Dr. J. B. Cleland exhibited an abnormal flower of one of the common West Australian species of *Candollea* (*Stylidium*), the corolla having an extra petal-lobe (six instead of five).

Mr. L. Harrison exhibited two females, adult and immature, of the oriental cuckoo, *Cuculus saturatus* Hodg., (= *C. intermedius* Vahl = *C. canoroides* Mull.) sent to him, in the flesh, from Broadwater, Richmond River, N.S.W., during April, 1907. This species was first recorded for New South Wales, at a meeting of this Society, on 28th June, 1905, when Mr. A. J. North exhibited a skin from the Tweed River, killed in August, 1902; and gave additional records of specimens from Gympie, Wide Bay, Port Denison, and Cairns in Queensland. It is frequently seen in collections from the Northern Territory, so that, even if not a regular migrant, it is a frequent visitor to Australia, and possibly to New South Wales. In Mathews' "Hand-List of the Birds of Australia," it is described as "accidental" for New South Wales, and the Northern Territory is omitted from the distribution. The birds exhibited were in company with two others of the same species, moving unobtrusively among the heavy scrub-timber; and constitute the most southerly record for the species. They were not heard to utter any note. The stomachs contained half-digested larvæ of a large hawkmoth. The specimens recorded from New South Wales are all females, which may indicate that this sex is more adventurous in its migrations than the male. It is interesting to note that the birds in question were obtained in April, when they would naturally be expected to have reached the Asiatic end of their range.

Mr. Basset Hull exhibited a skin and an egg of the "Big Hill Mutton Bird" of Lord Howe Island, and a skin and an egg of

*Estrelata neglecta* Schlegel, from the Kermadec Islands. The Lord Howe species is referred to under the specific name of the Kermadec bird in Mr. Hull's paper on the Birds of Lord Howe and Norfolk Islands (Proc. Linn. Soc. N. S. Wales, 1909, xxxiv., p.649), but he there expressed the opinion that the Lord Howe bird is a distinct species. This opinion is verified by a comparison of the two specimens exhibited, and by a fuller account, recently received from a resident, of the habits, and by examination of a series of the eggs of the Lord Howe bird. This is not only distinct from *E. neglecta*, but it is an undescribed species; and the exhibitor proposed to describe it in a further contribution to the Proceedings.

Mr. Froggatt showed (1) rust-galls on *Acacia pendula*, associated with mites (*Oribatidæ*), from Nevertire, N.S.W.; the galls were due to a fungus (*Uromyces*), apparently *U. tepperianum*; and the diseased condition may be spread by the mites. (2) Leaf-galls on *Eucalyptus* sp., caused by a species of *Phytoptus*; from Dandenong, Vic. (3) Leaf-galls on an undetermined scrub-tree, due to a mite of the same group; from Nevertire. And (4) peculiar growths on the terminal shoots of young *Eucalypts*, possibly of fungoid origin; from Katoomba, N.S.W.

Mr. Maiden exhibited coloured drawings of seedlings of *Eucalyptus corymbosa* Sm., with three cotyledons, from the Sydney district; also an example of *Eucalyptus patens* Benth., from Western Australia, with ternate juvenile leaves.

Mr. T. H. Johnston exhibited a series of Entozoa comprising the following—(1) Hydatids in the lung of a Paddymelon, *Macropus thetidis* Less. (New England, N.S.W.), and (2) of a Wallaroo, *M. robustus* Gould (N.S.W.), not previously recorded from these hosts; (3) *Coccidium* sp., from the intestinal walls of *M. thetidis* (N.S.W.), not previously known from this host, but apparently the same as that recently found by him in a similar situation in *M. parryi* Benn., from near Brisbane; (4) *Coccidium bigeminum* Stiles, from the intestine of a dog (Berry, N.S.W.), a sporozoon not previously recorded from Australia; in addition to the typical

elliptical form of spore, there were great numbers which possessed a pyriform shape; (5) *Uncinaria stenocephala* Raill., a rare parasite of the dog(N.S.W.), not previously reported from Australia; (6) *Anchylostoma caninum* Ercol., also from the dog (Victoria; collected by A. S. Le Souëf), recorded previously only from New South Wales and Queensland; and (7) *Physaloptera* sp., from Gould's Monitor, *Varanus gouldi* Shaw (Victoria; collected by A. S. Le Souëf).

Mr. A. S. Le Souëf showed a photograph of a male Wallaroo (*Macropus robustus*) which had been castrated when young. The usual colour of the male is black, and of the female light grey; but this gelded male, which has been in the Zoological Gardens, Sydney, for some years, is light grey like the female, yet otherwise possesses the usual masculine characters, for example, larger size and stouter build. He showed, also, a photograph of three Carpet Snakes of New South Wales (*Python variegata*) illustrating the great variation in this species; two well marked types and a transversely striped intermediate form were represented; one of the former is widely distributed, the other is more restricted (County of Cumberland and about 150 miles round); but the latter is comparatively rare; the specimen photographed came from Foster, N. S.W.

Mr. E. Cheel showed a series of noteworthy Fungi, comprising — MYXOGASTRÆ: *Arcyria nutans* Rost.; Dante's Glen, Lawson, Blue Mts., (Miss D. Wiles; communicated by Mr. A. G. Hamilton; June, 1910)—PERONOSPORACEÆ: *Peronospora schleideni* Ung.; host, cultivated eschalots (*Allium ascalonicum* Linn.); Penshurst (E. Cheel; August, 1910). Previously recorded by Dr. N. A. Cobb (Agricultural Gazette of New South Wales, 1891, p.616) as *P. schleideniana* De Bary, but without specific locality.—PUCCINIACEÆ: *Puccinia tasmanica* Diet.; host, common groundsel (*Senecio vulgaris* Linn.), Thornleigh (E. Cheel; August, 1910); æcidia-stage only. This species is recorded by McAlpine ("Rusts of Australia," p.163) as occurring on *S. pectinatus* DC.; collected by Mr. J. H. Maiden, on Mount Kosi.

usko; and also on *S. vulgaris* L., from specimens collected by Mr. A. G. Hamilton without specific locality; so far the teleuto-spore-stage has not been found in this State.—**PODAXACEÆ:** *Podaxon aegyptiacus* Mont.; Cobar(L. Abrahams; April, 1910), Girilambone(J. H. Maiden, and J. L. Boorman; August, 1910). Previously recorded from near Bourke (these Proceedings, 1906, p.721). Lloyd, in his "Lycoperdaceæ of Australia, New Zealand," etc.,(p.5; 1905) gives an excellent photograph of the Bourke specimen.

# A CONTRIBUTION TO THE STUDY OF THE PRECIPITINS.\*

By H. G. CHAPMAN, M.D., B.S.

(From the Physiological Laboratory of the University of Sydney.)

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## General historical introduction.

The existence of specific precipitins in the blood was first demonstrated in 1897 by Kraus,† who added cholera, plague, and typhoid antisera to filtered cultures of the corresponding germs. On the addition of the homologous culture-filtrate a precipitate was formed, but this did not appear if the antiserum was not homologous. These observations were confirmed by Nicolle,‡ who employed cultures of *Bacillus coli*, *B. typhi*, and *Vibrio marseillensis*. These investigators called the bodies present in the antisera employed by them agglutinins. In 1899 Bordet§ noted that rabbits, which had received several intraperitoneal

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\* Published by permission of the Council of the University of Melbourne, to whom it was submitted as a thesis for the David Syme Prize.

† Wien. klin. Wochenschr. x, S.736, 1897, quoted from Nuttall, Journ. of Hygiene, i., p.368, 1901.

‡ Ann. de l'Inst. Pasteur, xii., p.161, 1898.

§ Ann. de l'Inst. Pasteur, xiii., p.232, 1899.

injections of defibrinated blood from fowls, yielded a serum not only possessed of hæmolytic power against the red corpuscles of the fowl but also capable of giving rise, when mixed with fowl's serum, to a precipitate which slowly became abundant and aggregated into flocculi. In the same paper Bordet described "lacto-sera." He applied this term to antisera which precipitated caseinogen. Bordet\* stated that this property of antisera had already been investigated by Tchistovitch. Tchistovitch† stated that, on mixing the serum of the eel with a strong antitoxin from an animal (rabbit, hare, guinea-pig or dog) which had been immunised for a little time, a cloud and a precipitate similar to that which had been observed by M. Kraus in filtered cultures of germs, were obtained. This precipitate was insoluble in water, neutral salts and alkaline carbonates, but dissolved easily in alkalis and acids. Its formation resembled the coagulation of a substance dissolved in the toxic serum or antitoxin.

In 1900 Uhlenhuth‡ commenced his researches on the precipitins with a contribution on specific tests for egg-albumens. He concluded that, by repeated intraperitoneal administration of a solution of hen's egg-white into rabbits, there were formed in the serum bodies which, on their addition to solutions of hen's egg-white, gave rise to a cloud or precipitate; that similar results were seen with solutions of pigeon's egg-white; that the serum of rabbits treated with solutions of pigeon's egg-white contained bodies which produce clouds and precipitates in solutions of the egg-white of the fowl and pigeon; that the reaction so produced occurred only with egg-white, not with the numerous other proteins tested, and that the reaction showed great delicacy. In a later paper§ Uhlenhuth concluded that it would not be possible to differentiate eggs as had been possible for bloods. Gengou|| found that he was unable to observe any difference in the action of hen's

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\* Ann. de l'Inst. Pasteur, xiii, p.285, 1899.

† Ann. de l'Inst. Pasteur, xiii., p.406, 1899.

‡ Deutsch. med. Wochenschr. xxvi., 8,734, 1900.

§ *Ibid.* xxvii., 8,260, 1901.

Ann. de l'Inst. Pasteur, xvi., p.734, 1902.



egg-white antiserum upon solutions of the egg-whites of the fowl, duck, pigeon, and turkey. Nuttall,\* Levene,† and Graham-Smith‡ obtained analogous results. In 1901 Uhlenbuth§ applied this biological method to the separation of different kinds of blood, and especially to the identification of human blood. Wassermann and Schutze,|| Mertens,¶ Stern,\*\* Nuttall and Dinkelspiel,†† Zuelzer‡‡ and Ziemke§§ made important investigations on these applications of the test.

Kowarski||| immunised rabbits with extracts of wheaten meal from which the protein coagulated by heat had been filtered off. The antisera from such rabbits gave a precipitate with the extract used for immunisation. Similar precipitates were given with extracts of rye and barley. No precipitate occurred with extract of oats. A pronounced cloud formed with extract of peas. It was concluded that the vegetable proteins were not of such different kinds as the animal proteins

Bertarelli¶¶ examined the relations of the proteins of the bean, pea, lentil, and vetch. He injected dogs with the extracts from these seeds, and obtained weak antisera. No qualitative specificity could be detected.

Relander\*\*\* prepared antisera for the vetch and barley. He found the antisera to be specific for the two substances tested.

\* Journ. of Tropical Med., iv., p.408, 1902.

† Medical News, lxxix., p.981, 1901, quoted by Nuttall, Blood Immunity and Relationship, Cambridge, 1904.

‡ Nuttall, Blood Immunity and Relationship, Cambridge, 1904.

§ Deutsch. med. Wochenschr., xxvii., S.83, 499, and 780, 1901.

|| Deutsch. med. Wochenschr., xxvii., Vereinbeilage, S.80, 1901.

¶ Deutsch. med. Wochenschr., xxvii., S.161, 1901.

\*\* Deutsch. med. Wochenschr., xxvii., S.135, 1901.

†† Journ. of Hygiene, i., p.367, 1901.

‡‡ Deutsch. med. Wochenschr., S.219, 1901.

§§ Deutsch. med. Wochenschr., xxvii., S.424 and 731, 1901.

||| Deutsch. med. Wochenschr., xxvii., S. 442, 1901.

¶¶ Cent. f. Bact. xi., S.8, 1903.

\*\*\* Cent. f. Bact. xx., S.518, 1906.

Precipitin antisera have also been prepared for ricin,\* crotin, and ergot.† These have all shown a high degree of specificity.

*Scope of Inquiry.*

The study of the precipitins, as these bodies came to be called, progressed rapidly in the next few years, since they seemed to be concerned with those specific properties of the components of the tissues of different genera and species which had evaded the chemical tests formerly employed. Some investigators turned their attention to the details of the use of the test for the recognition of the blood and proteins of different forms in cases of legal interest. Others endeavoured to see whether the relations revealed in the zoological kingdom by the biological method were similar to those determined on morphological homologues. Others, again, examined the conditions of formation of these substances in the living body in the hope that they might lead to further insight into those complex interactions by which the animal organism defends itself against noxious microbic and chemical agents. In this way certain definite paths of research became established. With some of these lines of research the experiments recorded in this paper are concerned. In the first place, a further attempt has been made to elucidate the interaction between antiserum and homologous protein with the object of eliciting the quantitative relationships of the reaction. In the second place, the knowledge of the numerical relations of antiserum and protein has been utilised to arrange methods for the differentiation of the proteins of closely allied species, and to render more accurate the diagnosis of the source of individual proteins. In the third place, an attempt has been made to determine by the biological method the relationship of proteins of vegetable origin. The greatly improved knowledge of the technique for the use of precipitins will now enable differences to be recognised in these proteins. And, lastly, the application of the results obtained by gravimetric means to the deviation of complement is pointed out.

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\* Jacoby, *Hän. Beitr.* i., 8.51, 1901.

† Ottolenghi, *Biochem. Cant.* 1902, No. 1435.

*General Remarks on the Methods employed.*

The precipitin antisera were produced by the intraperitoneal injection of the serum, egg-white or solution containing protein into rabbits. In a few instances cats were employed. Subcutaneous and intravenous injections were attempted, but these methods of administration were not satisfactory. The rabbits were well fed, and frequently gained weight during immunisation. The large amount of food eaten was noticed. A rabbit weighing 1200 gm. would eat 400-600 gm. carrots in 24 hours. The rabbits were not fed on the day of injection until after the injection had been made. During the last three years the precaution of washing and shaving the rabbits' skins has been dispensed with. It was, however, of great importance that the syringe, needle, and fluid to be injected should be free from noxious organisms. The needle and syringe were rinsed in boiling water immediately before each injection. This simple but efficient method has much diminished the time of injecting the rabbits, so that twelve rabbits can be injected in a few minutes. Injections were at first made every 4 or 5 days, but experience soon showed that an injection every second day was well tolerated. In the last few immunisations daily injections were employed. The rabbits were weighed daily, and a sudden fall of weight was regarded as a sign to avoid injection for a day or two. The amount injected varied with the material used. Egg-white antisera seemed more powerful when the total amount of egg-white injected was large, so that 10 c.c. or 20 c.c. were given at each dose. With blood sera care had to be taken with the initial injections, which were usually 3 c.c. to 5 c.c. If the animal did not lose weight, the dose was increased to 10 cc. From six to eight injections were given. As very powerful antisera were obtained with five or six injections of small amounts of protein, making the total amount injected as 0.2 to 0.3 gm. dried protein equal to 2 to 3 c.c. blood serum, it was evident that the quantity of protein injected did not necessarily determine the amount of precipitin in the antiserum.

The animals were killed 7 to 12 days after the last injection. Nuttall's method\* was followed. The blood was caught in a large sterile dish which was at once covered. The serum was removed from the dish in 7 or 8 hours, and either sealed up in sterile tubes and stored on ice, or dried† in vacuo over calcium-chloride at 37°C. Dried antisera were kept in a securely closed sterile bottle. Every precaution was taken to work under aseptic conditions. All the tubes used for the interactions, all pipettes, measuring cylinders, and other apparatus were sterilised in a Koch's steam steriliser. The salt solution used as the diluent was sterilised by raising to the boiling point on three successive days. The trouble of these precautions was amply repaid by the tubes remaining sterile for 7 or 8 days after being set up. All the tubes were plugged with sterile cotton wool. When a bacterial deposit may have simulated or concealed a slight precipitate, the tubes have been rejected.

Measurements have been made with pipettes graduated to 1/100th of a cubic centimetre, and corrected by weighing the quantity of mercury delivered by them.

The tubes employed for the interactions were made of ordinary glass tubing of about 5 mm. bore. The ends were drawn out and rounded off. The bottom of each tube was thus shaped as a cone. For certain experiments, tubes of a larger bore—8 mm.—were employed.

#### *The Relations of the Interacting Substances.*

The characters of the interaction between the antiserum and the protein employed for its production, have been studied to determine the general laws governing the reaction. If a given weight or volume of antiserum be allowed to interact with increasing quantities of protein, the precipitate formed increases

\* Nuttall, *Blood Immunity and Relationship*, Cambridge, 1904, p. 59.

† On the advantage of using dried antisera, see Chapman, *Proc. Linn. Soc. N. S. Wales*, 1905, xxx., p. 392.

up to a maximum. Under certain conditions, Arrhenius and Hamburger have found that a precipitate may diminish again.

Some qualitative experiments may be quoted first. A series of tubes were arranged containing from 0.05 to 0.000000005 gm. dried horse-serum dissolved in 0.5 c.c. saline solution (0.75 per cent. sodium chloride) so that the dilution of the dried horse-serum in 0.5 c.c. saline solution varied from 1 in 10 to 1 in 10,000,000. A control tube containing 0.5 c.c. saline solution alone was also prepared. To each tube of the first series and to the control was added 0.01 gm. dried antiserum (prepared in a rabbit by the injection of 4.4 gm. dried horse-serum in 8 doses) previously dissolved in 0.5 c.c. saline solution. The precipitates were read in 48 hours by measuring the length of tube occupied by the precipitate. A record of the readings is given in Table i.

Table i.

No. of tube.	Grams of dried horse-serum in each tube.	Dilutions of dried horse-serum in 0.5 c.c. saline.	Precipitates in tubes to which 0.01 gm. dried antiserum was added.
1	0.05	1 in 10	1 mm.
2	0.005	1 in 100	1.5 mm.
3	0.0005	1 in 1,000	1.5 mm.
4	0.00005	1 in 10,000	1.5 mm.
5	0.000005	1 in 100,000	0.5 mm.
6	0.0000005	1 in 1,000,000	0.3 mm.
7	0.00000005	1 in 10,000,000	0.3 mm.
8	control.	saline alone.	none.

From this Table it is evident that in tubes 1, 2, 3, and 4 maximal precipitates have been produced, while in tubes 5, 6 and 7 submaximal precipitates have been formed. After 48 hours the superfluids above the precipitates were removed and 0.2 c.c. from each tube was placed in a clean tube. To each of these tubes containing superfluid, 0.0001 gm. dried horse-serum dissolved in 0.5 c.c. saline was added. After 48 hours the readings of these secondary interactions were taken. They are recorded in Table ii.

These results\* show that there was no additional precipitate in tubes 2 and 3, and small precipitates in tubes 4, 5, 6, 7 and 8.

Table ii.

No. of tube.	Precipitates after the addition of horse-serum.
1	not tested.
2	none.
3	none.
4	0.3 mm.
5	0.5 mm.
6	0.5 mm.
7	0.5 mm.
8	0.5 mm.

The maximum amount of precipitate is thus given by an amount of homologous protein which is adequate to precipitate all (or practically all) the precipitin. No further addition of protein will augment the precipitate.

Another series of secondary tubes was also prepared, by placing 0.2 c.c. superfluid of each of the primary tubes in clean tubes. To each was added 0.01 gm. dried antiserum dissolved in 0.5 c.c. saline solution. These secondary tubes were read in 48 hours. The results are recorded in Table iii.

Table iii.

No. of tube.	Precipitates after the addition of antiserum.
1	not tested.
2	2.5 mm.
3	1.5 mm.
4	0.5 mm.
5	0.3 mm.
6	0.3 mm.
7	0.3 mm.
8	none.

\* The reading of tube 1 is too small, since the interaction is not complete in 48 hours; compare Welsh and Chapman, *Journ. of Hygiene*, vi., p.258. 1906.

Precipitates were obtained in each tube. The homologous protein was thus not exhausted in any tube, and in spite of the fact that only one-fifth of the amount originally present was taken, it was still capable of eliciting from a second quantity of antiserum precipitates not less abundant than those obtained in the primary interactions. An apparent exception is tube 4, in which occurred a deposit much smaller than that primarily given. But the smaller precipitate in this instance reinforces the argument, since it is in all probability attributable not to the exhaustion of the homologous proteid but to the fact that the amount of horse-serum (0.00005 gm.) originally present was just insufficient to neutralise 0.01 gm. antiserum, and that the amount

Table iv.

No. of tube.	Amount of dried egg-white in grams.	Amount of dried antiserum in grams.	Precipitates in 48 hours.
1	0.0000012	0.01	0.3 mm.
2	0.0000024	"	"
3	0.0000036	"	"
4	0.0000048	"	"
5	0.0000060	"	"
6	0.0000072	"	"
7	0.0000084	"	"
8	0.0000096	"	1 mm.
9	0.000108	"	"
10	0.00012	"	"
11	0.00024	"	"
12	0.00036	"	"
13	0.00048	"	"
14	0.00060	"	"
15	0.0012	"	"
16	0.00060	"	"
17	0.00012	none.	none.
18	none.	0.01	none.

actually present in the secondary reaction was 0.00001 gm. (already once acted on), making the interacting quantities more nearly equal to those in the primary tube 5. In tubes 4, 5, 6 and 7 uncombined precipitin (antiserum) coexisted with uncombined homologous protein in the clear supernatant.

A series of experiments illustrative of the action between fowl's egg-white and fowl's egg-antiserum may now be described. The rabbit was immunised by the injection of 6.48 gm. dried egg-white in six doses. The antiserum was dried. Egg-white was diluted with saline solution to facilitate measurement. The solid content of the egg-white was determined by drying in vacuo over calcium chloride to constant weight. All the primary tubes were made up to 2.6 c.c. with 0.75 % sodium chloride solution. Table iv. records the primary interactions.

After 48 hours the superfluid above each precipitate was removed and filtered. The removed fluid was divided into three portions of 0.5 c.c. each, A, B, and C. To each tube of series A, 0.1 c.c. of 1 % egg-white in saline solution (0.00012) was added. To each tube of series B, 0.01 gm. dried antiserum dissolved in

Table v.

No. of tube.	Precipitates in series A (plus egg-white).	Precipitates in series B (plus antiserum).	Precipitates in series C (control).
1	1 mm.	0.3 mm.	none.
2	"	"	"
3	"	"	"
4	"	0.5 mm.	"
5	"	"	"
6	0.5 mm.	"	"
7	"	"	"
8	"	"	"
9	"	1 mm.	"
10	0.3 mm.	"	"
11	trace.	"	"
12	"	"	"
13	none.	2 mm.	"
14	"	"	"
15	"	"	"
16	"	"	"
17	"	"	"
18	1 mm.	none.	"

0.1 c.c. saline solution was added. The tubes of series C formed controls. After 48 hours, readings were taken, and these are recorded in Table v.



The results of this experiment show that in reactions 1 to 12 a quantity of precipitin has not been neutralised by the albumen. In reactions 13 to 16 the precipitin has been neutralised. It also shows that in every tube in which egg-white was present the further addition of antiserum caused a precipitate. On examination of the quantities it will be seen that a quantity of egg-white between 0.000036 gm. and 0.000048 gm. completely neutralised the precipitin in 0.01 gm. antiserum. The deposits given in Table v., Series A, show that the amount of precipitin decreased in tube 1 to tube 12, and that very little was present in tubes 11 and 12. It should be noted that not more than one fifth of the original precipitin can be present in the tubes of Series A, and one-fifth of the original egg-white in the tubes of Series B recorded in Table v. The results of these typical experiments have been confirmed by comparison with similar experiments. Thus five other series have been made between solutions of fresh and dried egg-white and five other fowl's egg-white antisera (two of which were not dried), one series between ostrich egg-white and dried ostrich egg-white antiserum, one series between the serum of the dasyure and an antiserum for dasyure serum, one series between the serum of the bandicoot and an antiserum prepared against the serum of the bandicoot, and one series between fresh horse and a corresponding antiserum. From similar data Welsh and Chapman\* concluded that, for constant quantities of precipitin interacting with varying amounts of homologous protein, the amount of precipitum remains constant as soon as sufficient homologous protein is present to neutralise all the precipitin.

These experiments serve to determine approximately the quantity of homologous protein which will neutralise the precipitin in a given weight of antiserum. Table vi. records the results obtained.

It is of interest to record in Table vii., the maximal precipitates obtained on complete neutralisation of the precipitin in these antisera.

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\* Journ. of Hygiene, vi., p.252, 1906.

These maximal precipitates were obtained by mixing 0.02 gm. dried antiserum and 0.004 gm. dried homologous protein. The reaction was allowed to take place in a pipette graduated to

Table vi.

Antiserum.	Weight in grams of protein always insufficient to neutralise 0.01 gm. antiserum.	Weight of protein usually sufficient to neutralise 0.01 gm. antiserum.	Weight in grams of protein always sufficient to neutralise 0.01 gm. antiserum.
Hen egg 1	0.000012	0.000024	0.000048
Hen egg 2	0.00001	0.00002	0.00003
Hen egg 3	0.00001	0.000025	0.00006
Ostrich egg	0.0005	—	0.002
Horse serum 1	0.00005	0.0001	0.0005
Horse serum 2	0.0005	—	0.002
Dasyura serum	0.0001	—	0.0005

hundredths of a cubic centimetre. The volume of the precipitate was read in 48 hours. On comparing Tables vi. and vii., it is seen that there is no correspondence between the amount of protein

Table vii.

Antiserum.	Volume of precipitum from 0.01 gm. dried antiserum.
Hen egg 1	0.024 c.c.
Hen egg 2	0.021 c.c.
Hen egg 3	0.010 c.c.
Ostrich egg	0.10 c.c.
Horse serum 1	0.024 c.c.
Horse serum 2	0.008 c.c.
Dasyura serum	0.0025 c.c.

necessary to neutralise the precipitin in an antiserum and the amount of precipitate to be obtained from an antiserum on neutralising the precipitin completely.

Other series of experiments have been carried out in which the amount of homologous protein was constant and the amount of antiserum was varied. Such a series is recorded in Table viii.

It will be seen from the results recorded in the Table that the amount of precipitate is directly proportional to the amount of antiserum, i.e., the quantity of precipitin.

Table viii.

No. of tube.	Weight of dried egg-white in gms.	Weight of dried antiserum in gms.	Precipitates after 48 hours in mm.
1	0.0001	0.01	2.0
2	0.0001	0.0075	1.5
3	0.0001	0.005	1.0
4	0.0001	0.0025	0.5
5	0.0001	0.001	trace.

More accurate methods, however, are required to determine the relation between the weights of interacting antiserum and homologous protein and the weight of the precipitate formed. The precipitates have been, therefore, weighed, and an examination of the precipitin reaction carried out by gravimetric methods. Measured quantities of fluid antiserum or weighed quantities of dried antiserum have been mixed with weighed amounts of protein in large tubes for the centrifuge. The tubes have been made up to a fixed volume with saline solution and allowed to stand 48 hours for the interaction to take place. The superfluid above the precipitate has been removed with a pipette and the precipitate washed five times with saline solution. Each time the precipitate has been mixed with 50 c.c. saline solution and the precipitate separated by spinning in the centrifuge. The precipitate has been then washed five times in the same way with 50 c.c. distilled water. The precipitate has been transferred to small glass tubes with thin walls, weighing about 4 gms. These tubes could be spun in a small centrifuge, and in this way the precipitate has been washed with absolute alcohol and finally with ether free from water. The tubes with their contents have been placed in an oven at 80°C. for several hours and thence put into the desiccator. The tubes have been kept a fixed time in the desiccator and weighed. The weights have been checked three

times. The tubes of a series have been weighed immediately after each other. Owing to the hygroscopic nature of the precipitates the error in the weights of the tubes has been found by experiment to be 0.3 mg. The mean figure of the several weighings has been taken in all cases.

Experiments were performed to ascertain the weight of precipitate obtained when a measured quantity of antiserum was allowed to interact with increasing weights of homologous protein. It has already been shown (*supra vide*) that no precipitin can be detected in the superfluid at the end of an interaction, provided that the amount of homologous protein exceeds a certain quantity. Table vi. records some of the results obtained by testing the superfluid with a further addition of protein and noting the presence or absence of a further precipitate. In the series to be described, the quantity of protein was sufficient to neutralise or precipitate\* the precipitin in the antiserum. The superfluids were considered free from precipitin since they yielded no precipitate on the addition of 144 mg. dried egg-white. The results are recorded in Table ix.

Table ix.

No. of tube.	Weight of dried egg-white in milligrams.	Volume of antiserum in cubic centimetres.	Volume of saline solution in cubic centimetres.	Weight of precipitate in milligrams.	Weight of precipitate in milligrams from 1 c.c. antiserum.
1	14.4	2 c.c.	50 c.c.	3.2	1.6
2	36.0	2 c.c.	50 c.c.	3.5	1.75
3	144.0	2 c.c.	50 c.c.	3.4	1.7
4	432.0	2 c.c.	50 c.c.	3.4	1.7

Here the antiserum was formed by the injection of hen's egg-white, and the fresh antiserum allowed to interact with fresh egg-white. A portion of the egg-white was dried to determine the solid content of the solution. The precipitates are stated in terms of the amount yielded with 1 c.c. antiserum. The weight

\* Compare Welsh and Chapman, Proc. Roy. Soc. London, B 78, p.297, 1906.

of precipitate remains practically constant although the protein increases from 14 gm. to 432 gm. A somewhat similar series is recorded in Table x. In this series 3 c.c. antiserum were allowed to interact with 70, 140, 280 and 560 mg. dried egg-white. After 24 hours the superfluids were removed; to the superfluid of the first tube 70 mg. dried egg-white were added, to the second tube 140 mg. dried egg-white were added, and the remaining tubes were tested in the usual way. The precipitates were treated in the manner above described and weighed. No precipitates occurred in the secondary tubes 3 and 4.

Table x.

Tube.	Weight of dried egg-white.	Amount of antiserum.	Amount of saline solution.	Weight of precipitate.	Total weight of the precipitates.	Total amount of precipitate from 1 c.c. antiserum.
1	70 mg.	3 c.c.	50 c.c.	2.8 mg.	3.5 mg.	1.16 mg.
1B	plus 70 mg.			0.7 mg.		
2	140 mg.	3 c.c.	50 c.c.	3.2 mg.	3.2 mg.	1.06 mg.
2B	plus 140 mg.			trace.		
3	280 mg.	3 c.c.	50 c.c.	3.0 mg.	3.0 mg.	1.0 mg.
4	560 mg.	3 c.c.	50 c.c.	3.2 mg.	3.2 mg.	1.06 mg.

The superfluids from tubes 2B and 1B were tested for the presence of precipitin by the addition of more protein, but no precipitates were obtained. In this series the weight of precipitate obtained from 1 c.c. antiserum remains constant despite the large increase in the quantity of protein. No stress can be laid on the amount of precipitate in tube 1B, since it is doubtful whether the interaction in tube 1 was complete in 24 hours.

As it appears that the precipitate from a given quantity of antiserum is constant, provided there be sufficient protein to neutralise the precipitin, a series of experiments in which the amount of antiserum was varied may be considered. With these experiments may be considered one in which a duplicate was carried out. The details of the experiments were varied to avoid errors. The results are recorded in Table xi.

These results show that the amount of precipitate yielded by each antiserum is a fixed quantity for each cubic centimetre of antiserum. It must be noticed that the amount of saline solu-

Table xi.

Tube.	Antiserum.	Amount of antiserum	Weight of dried protein.	Amount of saline solution.	Weight of precipitate.	Weight of precipitate from 1 c.c. antiserum.
1	Horse-serum 57	2.5 c.c.	100 mg.	50 c.c.	3.7 mg.	1.5 mg.
2	"	2.5 c.c.	100 mg.	"	3.5 mg.	1.4 mg.
3	Hen egg-white 59	2.0 c.c.	134 mg.	"	8.6 mg.	4.3 mg.
4	"	3.0 c.c.	134 mg.	"	12.5 mg.	4.2 mg.
5	"	4.0 c.c.	134 mg.	"	16.7 mg.	4.2 mg.
6	Horse-serum 53	2.5 c.c.	50 mg.	"	2.0 mg.	0.8 mg.
7	"	5.0 c.c.	200 mg.	"	4.0 mg.	0.8 mg.
8	Horse-serum 56	5.0 c.c.	100 mg.	"	10.4 mg.	2.1 mg.
9	"	10.0 c.c.	100 mg.	"	20.0 mg.	2.0 mg.
10	Hen egg-white 64	1.0 c.c.	28 mg.	"	1.4 mg.	1.4 mg.
11	"	2.0 c.c.	28 mg.	"	2.2 mg.	1.35 mg.
11B	"		plus 140 mg.		0.5 mg.	
12	"	3.0 c.c.	28 mg.	"	3.2 mg.	1.4 mg.
12B	"		plus 50 mg.		1.0 mg.	
13	"	4.0 c.c.	28 mg.	"	3.6 mg.	1.5 mg.
13B	"		plus 56 mg.		2.4 mg.	

tion used as a diluent is the same throughout the series. In tubes 1 and 2, 2.5 c.c. antiserum for horse-serum interacted with 100 mg. dried horse-serum, and the duplicates agree well. In tubes 3, 4, and 5, 2 c.c., 3 c.c., and 4 c.c. fowl's egg-white antiserum interacted with 100 mg. dried egg-white, yielding 8.6 mg., 12.5 mg., and 16.7 mg. precipitate respectively. Calculating the amount for each c.c. antiserum, it is found to be about 4.2 mg. in each case. In tubes 6 and 7, 2.5 c.c. antiserum for horse-serum reacted with 50 mg. horse-serum, and 5.0 c.c. antiserum reacted with 200 mg. horse-serum. The amount of precipitate in the second tube was exactly double that in the first tube. In tubes 8 and 9, 5 c.c. and 10 c.c. antiserum each interacted with 100 mg. dried egg-white, and the weights of the precipitates agree sufficiently well. In tubes 10, 11, 12, and 13, 1 c.c., 2 c.c., 3 c.c., and 4 c.c. antiserum for fowl's egg-white each reacted with 28 mg.

dried egg-white. After 48 hours the superfluids were removed and a quantity of dried egg-white dissolved in saline solution added to each superfluid. No further precipitate formed in tube 1, but precipitates formed in 11B, 12B, and 13B. Here again there is fair agreement in the amount from each 1 c.c. antiserum.

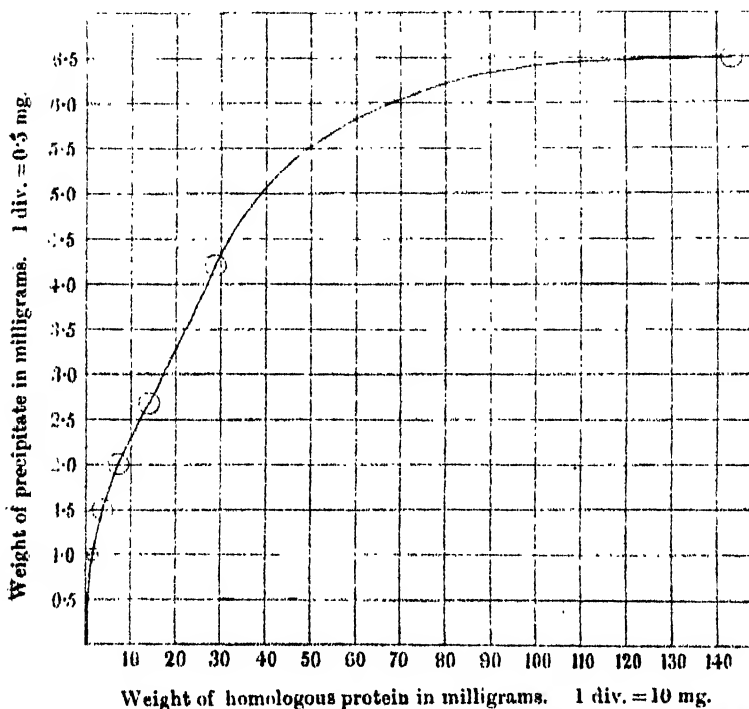
When the amount of protein is insufficient to neutralise all the precipitin in a given quantity of antiserum, the amount of precipitate is diminished. An experiment showing the relation of the precipitate to the amounts of the interacting bodies may be now described. A rabbit was immunised by the injection of 9.6 gm. dried egg-white in eight doses. The antiserum was employed fresh. A solution of egg-white was used for the homologous protein and the solid content determined by drying a fixed quantity. The quantities employed and the results are recorded in Table xii.

Table xii.

Tube.	Amount of antiserum.	Weight of protein.	Amount of saline solution.	Weight of precipitate.	Weight of precipitate from 1 c.c. antiserum.
1	3 c.c.	1.44 mg.	50 c.c.	1.0 mg.	0.33 mg.
2	3 c.c.	3.6 mg.	50 c.c.	1.5 mg.	0.5 mg.
3	3 c.c.	7.2 mg.	50 c.c.	2.0 mg.	0.66 mg.
4	3 c.c.	14.4 mg.	50 c.c.	2.7 mg.	0.9 mg.
5	3 c.c.	28.8 mg.	50 c.c.	4.2 mg.	1.4 mg.
6	3 c.c.	14.4 mg.	50 c.c.	6.5 mg.	2.2 mg.

It will be seen that the amount of antiserum was 3 c.c. in each tube. This quantity yields only a small precipitate in the tubes 1 and 2, so that great stress cannot be placed on these figures. The weights of the precipitates have been set in the graph appended (fig. 1). The curve tends to be of a regular form. The amount of antiserum obtained from a rabbit is not usually more than 20 c.c., so that extended series cannot be carried out with antisera from rabbits. It was not considered legitimate to employ mixed antisera. Another series gave a graph of similar form. At present the data are too few to discuss these results at length, in order to determine the type of the interaction.

The effect of the degree of dilution on the weight of precipitate may be now considered. Two series of experiments were carried out. In the first series the quantity of egg-white was constant,



Curve of weight of precipitate formed with increasing weights of homologous protein: 3 cc. antiserum interact with ascending weights of dried egg-whites.

and the amount of saline solution used to dilute the interacting masses was varied. In the second series the quantity of egg-white was maintained at a constant concentration in the saline solution. The antisera employed were two fowl's egg-white antisera prepared from rabbits. The results are recorded in Table xiii.



The results of both series correspond, though the absolute amount of precipitate from each antiserum was different. With a quantity of saline solution of 25 c.c., there was a reduction in

Table xiii.

Tube.	Amount of antiserum.	Weight of egg-white.	Amount of saline solution.	Weight of precipitate.	Weight of precipitate from 1 c.c. antiserum.
1	5 c.c. A	100 mg.	25 c.c.	10.8 mg.	2.2 mg.
2	5 c.c. A	100 mg.	50 c.c.	16.2 mg.	3.2 mg.
3	5 c.c. A	100 mg.	100 c.c.	15 mg.	3.0 mg.
4	5 c.c. B	100 mg.	25 c.c.	10.6 mg.	2.1 mg.
5	5 c.c. B	200 mg.	50 c.c.	19.5 mg.	3.9 mg.
6	5 c.c. B	400 mg.	100 c.c.	17.7 mg.	3.6 mg.

the amount of precipitate. All observers have noted this reduction, which has been usually ascribed to a solvent action of the concentrated serum. With a quantity of saline solution of 100 c.c., the precipitates were also reduced slightly. This reduction was probably due to incomplete reaction in 48 hours, since the superfluids removed from tubes 3 and 6 yielded small precipitates on standing for another 48 hours. These results are in accord with the qualitative results previously\* obtained.

#### *Determination of Specific Relations.*

It has already been shown that, under the conditions before described, a given quantity of antiserum gives rise to a certain weight of precipitate, provided a sufficient amount of homologous protein be present. If the protein of the homologous species be replaced by the protein of a closely related species (as tested by the biological method) the amount of precipitate from that quantity of antiserum is diminished.

It is not practicable to weigh the precipitate from a given quantity of antiserum interacting with a quantity of unknown protein, as a means of differentiation of proteins. This same

\* Welsh and Chapman, Journ. of Hygiene, vi., p.256, 1906.

principle adapted to other circumstances has been employed to distinguish between closely related proteins, *e.g.*, those of avian eggs. As an example, an experiment may be considered which records the interaction between an antiserum for fowl's egg-white and the egg-white of the hen, duck, quail, ostrich, partridge, and pheasant, by which the heterologous egg-whites of the different eggs were clearly distinguished from the hen's egg-white. The antiserum was derived from a rabbit which had received six injections of egg-white containing 6.27 gm. dried egg-white. When the rabbit was killed, the antiserum was dried *in vacuo* over calcium chloride at 37°C. At the time the experiments were performed, the dried antiserum was over two months old. For the experiment, 0.13 gm. dried antiserum was dissolved in 5.2 c.c. saline solution. The antiserum was thus diluted so that 0.4 c.c. solution was equivalent to 0.01 gm. dried antiserum, 0.2 c.c. solution to 0.005 gm. antiserum, 0.08 c.c. solution to 0.002 gm. antiserum, 0.04 c.c. solution to 0.001 gm. antiserum, and 0.02 c.c. solution to 0.0005 gm. antiserum. To interact with the antiserum, 1 c.c. egg-white of each kind of egg was diluted with 99 c.c. saline solution, and 0.1 c.c. of the solution of each

Table xiv.

Tube.	Weight of antiserum.	Amount of the original solution of antiserum.	Amount of saline solution added to solution of antiserum.	Amount of diluted egg-white, fowl, duck, ostrich, pheasant, partridge, and quail.
1	0.01 gm.	0.4 c.c.	0.1 c.c.	0.1 c.c.
2	0.005 gm.	0.2 c.c.	0.3 c.c.	0.1 c.c.
3	0.002 gm.	0.08 c.c.	0.42 c.c.	0.1 c.c.
4	0.001 gm.	0.04 c.c.	0.46 c.c.	0.1 c.c.
5	0.0005 gm.	0.02 c.c.	0.48 c.c.	0.1 c.c.
6	none.	none.	0.5 c.c.	0.1 c.c.

kind of egg-white placed in each of six tubes. The antiserum was measured out in quantities of six times that required for each tube, and saline solution added in such quantity that the

amount of diluted antiserum for each tube measured 0.5 c.c. In this way it was possible to measure the small amounts of antiserum with some approach to accuracy. The quantities of the interacting bodies are recorded in Table xiv.

Tubes of 4 to 5 mm. bore were employed. Each tube contained 0.6 c.c. fluid. The readings of the precipitates after 48 hours are given in Table xv.

Table xv.

Amount of antiserum	Fowl's egg-white.	Duck's egg-white.	Pheasant's egg-white.	Partridge's egg-white.	Quail's egg-white.	Ostrich's egg-white.
0.01gm.	2.5 mm.	1.0 mm.	1.0 mm.	0.8 mm.	0.8 mm.	0.5 mm.
0.005gm.	1.0 mm.	0.3 mm.	0.5 mm.	0.5 mm.	0.3 mm.	0.3 mm.
0.002gm.	0.3 mm.	trace.	trace.	trace.	trace.	trace.
0.001gm.	trace.	trace.	trace.	none.	none.	trace.
0.0005gm.	trace.	none.	none.	none.	none.	none.
none.	none.	none.	none.	none.	none.	none.

The results show that the amount of precipitate with fowl's egg-white was 2.5 mm., greater than the precipitate with any heterologous protein. It is also evident that, by testing with diminishing quantities of antiserum, the differentiation is easily made. Although 43 tubes were employed, including controls of antiserum and saline solution, and protein and saline solution, the amount of dried antiserum employed was only 0.13 gm., equal to 1.3 c.c. fresh antiserum. The method is therefore economical with material. When the quantity of heterologous protein interacting with 0.01 gm. dried antiserum is increased to produce the maximum precipitate, the amount of precipitate is less than the full precipitate for that amount of antiserum yielded by the homologous protein. This is evident from the results recorded in Table xvi. This table records the results of an experiment similar to that recorded in Tables xiv. and xv., tube 1, but carried out with another antiserum. After 48 hours, the superfluids were removed to clean tubes and treated with a second 0.1 c.c. solution of protein.

The readings show that the combined precipitates with the heterologous protein did not equal the precipitate with the homologous protein.

Table xvi.

Tube.	Weight of antiserum.	Amount of diluted egg-white.	Reading in 48 hours.	Addiment to superfluid.	Reading after 48 hours.
1	0.01 gm.	0.1 c.c.(fowl).	1.5 mm.	0.1 c.c.(fowl).	0.3 mm.
2	0.01 gm.	0.1 c.c.(duck).	0.5 mm.	0.1 c.c.(duck).	none.
3	0.01 gm.	0.1 c.c.(ostrich).	0.5 mm.	0.1 c.c.(ostrich).	0.5 mm.

Another method of differentiation of closely related proteins has been described by Welsh and Chapman.\* This method depends on the inhibition of the formation of precipitate by heated antisera, i.e., on the solution of precipitate by heated antisera. It is not, however, so simple as that described above, as it involves a thorough knowledge of the inhibitory powers of the antisera employed, and requires a detailed examination of each antiserum before use. The results obtained in the research on crossed inhibition led Welsh and Chapman to suggest that the precipitate given by hen-egg antiserum and ostrich or any egg albumen other than hen-egg albumen might be regarded as similar to that produced by ostrich-egg antiserum and any egg albumen other than ostrich-egg albumen. It could be assumed that this precipitate resulted from the general avian character or component of the proteins used in immunisation, while the greatly increased precipitate produced by hen-egg albumen and hen-egg antiserum, or by ostrich-egg albumen and ostrich-egg antiserum could be assumed to be due to the specific hen or ostrich character or component of the material used for injection. In this connection, some observations made on the eggs used for the experiment recorded in Tables xiv. and xv., may be noted. After

\* The principles of this method are outlined by Welsh and Chapman, Proc. Roy. Soc. London, B.79, p.471, 1907.

48 hours the reactions recorded in Table xv. were complete and the precipitates were read. The superfluids of tubes 1 were removed and to the superfluids certain addiments of solutions of egg-white were made. The solutions were those used in the primary experiments. The observations are recorded in Table xvii.

Table xvii.

Tube.	Original protein present.	Addiment of protein.	Amount of precipitate after 48 hours.
1	0.1 c.c. (fowl).	0.1 c.c. (ostrich).	none.
2	0.1 c.c. (duck).	0.1 c.c. (ostrich).	trace.
3	0.1 c.c. (pheasant).	0.1 c.c. (partridge).	0.5 mm.
4	0.1 c.c. (partridge).	0.1 c.c. (fowl).	1.5 mm.
5	0.1 c.c. (quail).	0.1 c.c. (partridge).	none.
6	0.1 c.c. (ostrich).	0.1 c.c. (duck).	0.5 mm.

In the interpretation of these results, those recorded in Table xvi., must be considered. The presence or absence of a precipitate shows that in tube 1 the additional ostrich egg-white failed to produce a precipitate, as the general avian precipitin was already completely neutralised; in tube 2 there was no precipitate for the same reason; in tube 3 the additional egg-white of the partridge neutralised and precipitated the remaining precipitin; in tube 4 the fowl egg-white neutralised the specific precipitin for the fowl egg-white, yielding therefore a large precipitate; in tube 5 the partridge egg-white failed to reveal any general avian precipitin remaining present; and in tube 6 the duck egg-white neutralised and precipitated the remaining general avian precipitin. These results have also an interest in the light of the similar properties of certain hæmolytic sera. The amboceptors present in these latter, combine with the corpuscles from one species of animal, but after the corpuscles of this species have extracted all the amboceptors capable of union with the corpuscles, the corpuscles of a second species will unite with other amboceptors present in the hæmolytic sera.

*Observations on the Precipitins for Vegetable Proteins.*

The study of the biological relationships of plants by means of precipitins is much more difficult than those of animals. This is due to the difficulty of obtaining material in which reactions, other than those between the interacting precipitin and protein, do not occur. In the first place, the solution of proteins for intraperitoneal injection of the rabbits must be prepared free from toxic substances. Such solutions must also be sterile. The careful researches\* of Dr. J. M. Petrie, in this laboratory, on the seeds of the *Acacias*, have led to the choice of the proteins of these seeds for preparing the antisera. As further work on the decomposition-products of these proteins is likely to be carried out, and as these proteins may differ widely in chemical properties from the proteins of blood-sera, it may be possible to determine by chemical means whether the precipitates formed in the precipitin reactions are composed of substances akin to the proteins of the *Acacias*. Recent investigations† of the acidic properties of the proteins and their union with bases, also offer means for the preparation of purer solutions of proteins than have hitherto been obtained. As extracts of the seeds of the *Acacias* made with 10 % salt solution contain little toxic matter, these extracts have been employed for injection after filtration and dilution. They have been sterilised by heating to 55°C., from 3 to 6 hours. Antisera prepared with heated proteins have been studied by Schmidt.‡ They may be used for the same purposes as antisera prepared with unheated protein. Similar but less extensive experiments with antisera made with heated protein have been carried out in this laboratory with the same results.

The antisera prepared by the injection of these heated proteins have been allowed to interact with solutions of the seeds of different species of plants. The solutions were made by extract-

\* Proc. Linn. Soc. New South Wales, 1908, xxxiii., p. 835.

† Brallford Robertson, "The Proteins," University of California Publications, 1909.

‡ Biochem. Zeitschr. xiv., S. 294, 1908.

ing 0.5 gm. powdered seeds with 10 c.c. saline solution. The extracts were filtered and divided into two parts; one part was then heated to 70°C. for 4 hours and filtered, while the second part was unheated. The heated extract was sterile, and the tubes did not show bacterial changes for some days. The unheated extract soon showed signs of putrefaction. In addition to the usual controls, it was necessary to arrange, each time, a series of tubes in which normal rabbit's serum interacted with the extracts of the seeds. The importance of this control is evident from Table xviii.

Table xviii.

Tube.	Seeds.	Amount of extract.	Amount of rabbit's serum.	Precipitate with	
				Unheated extract.	Heated extract.
1	<i>Acacia pycnantha.</i>	0.5 c.c.	0.1 c.c.	none.	none.
2	<i>Sinapis alba.</i>	"	"	0.5 mm.	2.5 mm.
3	<i>Albium porrum.</i>	"	"	2.0 mm.	2.5 mm.
4	<i>Chattachloro italica.</i>	"	"	0.5 mm.	3.0 mm.
5	<i>Casuarina distyla.</i>	"	"	trace.	0.5 mm.
6	<i>Humia elegans.</i>	"	"	none.	none.
7	<i>Astroloma pinifolium.</i>	"	"	2.0 mm.	none.
8	<i>Hemicyclia australasica.</i>	"	"	trace.	none.
9	<i>Endiandra Sieberi.</i>	"	"	solid.	8.0 mm.
10	<i>Macadamia ternifolia.</i>	"	"	0.3 mm.	none.
11	<i>Solanum verbascofolium.</i>	"	"	none.	none.
12	<i>Podocarpus elata.</i>	"	"	trace.	none.
13	<i>Pimelea ligustrina.</i>	"	"	none.	trace.
14	<i>Eucalyptus sideroxyton.</i>	"	"	none.	0.5 mm.
15	<i>Ficus rubiginosa.</i>	"	"	trace.	1.0 mm.
16	none(control).	"	"	none.	—

It is seen that 11 out of the 15 seeds gave extracts which yielded precipitates with normal serum. These extracts could not be used for tests with antiserum.

A series may now be recorded in which the preliminary tests and controls were satisfactory. This experiment is recorded in Table xix.

The antiserum was prepared by the injection of extracts of the seeds of *Acacia pycnantha* containing 3.0 gm. dried protein, given

in six doses. The tests were carried out by mixing 0.1 c.c. anti-serum and 0.5 c.c. extract of the seeds to be tested. Both heated and unheated extracts of the seeds were employed. The controls are omitted from the table.

Table xix.

Tube.	Natural Order.	Species.	Heated extract.	Unheated extract.
1	Leguminosæ.	<i>Acacia pycnantha.</i>	ppt.	ppt.
2	"	<i>A. penninervis.</i>	ppt.	ppt.
3	"	<i>A. nerriifolia.</i>	ppt.	ppt.
4	"	<i>A. leptoclada.</i>	ppt.	ppt.
5	"	<i>A. accolu.</i>	ppt.	ppt.
6	"	<i>A. spectabilis.</i>	ppt.	ppt.
7	"	<i>A. pendula.</i>	ppt.	ppt.
8	"	<i>Pisum sativum.</i>	ppt.	ppt.
9	"	<i>Phaseolus lunatus.</i>	nil.	nil.
10	"	<i>Vicia faba.</i>	nil.	—
11	"	<i>Medicago sativa.</i>	nil.	ppt.
12	Gramineæ.	<i>Triticum vulgare.</i>	nil.	nil.
13	"	<i>Avena sativa.</i>	nil.	—
14	Myrtaceæ.	<i>Eucalyptus sideroxylon.</i>	nil.	nil.
15	Conifera.	<i>Podocarpus elata.</i>	nil.	nil.
16	Solanaceæ.	<i>Solanum orrhacifolium.</i>	nil.	nil.
17	Epacridæ.	<i>Astraloia pinifolium.</i>	nil.	nil.
18	Compositæ.	<i>Humra elegans.</i>	nil.	nil.
19	Proteaceæ.	<i>Macadamia ternstroffii.</i>	nil.	

Quantitative differences in the amounts of the precipitates are not recorded in the table. In the first place, it may be noted that the seeds of the Natural Order of the Leguminosæ are marked off clearly from the seeds of the other well marked Natural Orders. In the second place, certain of the seeds of the Leguminosæ do not react with the antiserum for *Acacia pycnantha*. These results have been repeated with other antisera with similar results. It is probable that the precipitin test will be equally useful in the vegetable kingdom as in the animal kingdom. It possesses also the possibility of supplying data\* for a correct appreciation of the value of morphological characters in the differentiation of species.

\*An extended research on this aspect is being carried out in collaboration with Dr. Petrie.



*The Relation of Deviation of Complement to Precipitinum.*

Moreschi, in his first paper\* on the phenomena of deviation, showed that the fixation of complement appeared only as a sequel of precipitation. In his second paper† he was less decided on this point, but held that the amount of complement fixed was proportional to the amount of precipitate. Neisser and Sachs‡ were of opinion that the essential feature in the deviation of complement was the union of a substance (antigen) with its antibody. Gay§ regarded the precipitate as the all-important factor in the fixation of complement. He found that, after the precipitate had formed, the superfluid did not bind complement, but that the precipitate, even after thorough washing, fixed complement. Muir and Martin|| investigated the relation of deviation of complement to the precipitin test. They concluded, *inter alia*, that a mixture of serum and its antiserum had the property of fixing or deviating complement and thus interfering with hæmolysis, that the amount of homologous protein necessary to produce a distinct deviation of complement was extremely small, 0·00001 c.c. or even less—as a rule it was many times less than the amount necessary to give a visible precipitate with the antiserum—that when a precipitate formed, the deviating substance was present in the precipitate and might be so exclusively, and that the precipitation was not essential to the deviation-phenomena, as these could be given without the formation of a precipitate. Welsh and Chapman¶ have, however, found consistently that precipitates form in 48 hours with quantities as small as those employed by Muir and Martin. Stress need not be laid on this point, as there is now general agreement that it is the product of the interaction of antigen and antibody, and not a

\* Berl. klin. Wochenschr. S.1181, 1905.

† Berl. klin. Wochenschr. S.76, 1906.

‡ Berl. klin. Wochenschr. S.1388, 1905.

§ Ann. de l'Inst. Pasteur, xix., p.593, 1905.

|| Journ. of Hygiene, vi., p.265, 1906.

¶ Journ. of Hygiene, vi., p.359, 1906.

simple mixture of these substances, that has to do with fixation of complement.

Moll,\* Welsh and Chapman,† and Rodet‡ have brought forward much evidence to show that the precipitate or final product of the interaction of antiserum and homologous protein is mainly derived from the antiserum. Michaelis,§ in his recent summary of precipitins, does not accept the general conclusion, but grants that with the quantities employed by Welsh and Chapman this conclusion holds. He writes "that these observers have only had regard to mixtures of much precipitin and little precipitable substance . . . . and have rightly concluded that the precipitate consists wholly or almost wholly of the proteins (Eiweisskörpern) of the precipitin serum." Now the quantities of which Michaelis is writing show a much greater proportion of homologous protein to antiserum than those employed by Muir and Martin and other workers on deviation of complement. Disregarding for the present purpose the source of the precipitate under all circumstances, it can be accepted that the precipitate which usually brings about deviation of complement is derived mainly from the antiserum. It therefore follows that the amount of complement deviated will be proportional to the amount of antiserum used as antibody. It has been shown above that an increase in the amount of antiserum leads to an increase in the amount of precipitate, so that by increasing the amount of antiserum (antibody) deviation of complement may be obtained with smaller amounts of homologous protein. This factor has not yet received attention in work upon deviation of complement.

*Remarks upon the Practical Applications of the Precipitins.*

As pointed out in the introduction, the precipitin test was applied early to the diagnosis of the source of blood-stains.

\* Quoted by Rodet, *loc. cit.*

† Proc. Roy. Soc. London, B.lxxviii., p.810, 1906.

‡ Comp. rend. Soc. Biol. Paris, p.671, 1906.

§ Oppenheimer, *Handbuch der Biochemie*, Jena, 1909, Bd.ii., Hft.1, S.565.

During the subsequent years the range of application has been much extended.\* The increased attention to public health and food-supply has led to the use of the test in analytical work concerned with meat and animal foods generally. A detailed account of the methods employed in the use of the test in routine examinations in a municipal laboratory is given by Fornet and Müller.† The test has also been utilised in medical diagnosis. The application of the test to the diagnosis of hydatid disease, so prevalent in this country, may be cited. The small amount of manipulation required for these tests, and the speed with which a result may be obtained, give this test a great advantage over the test for deviation of complement which is used for the same purposes.

\* For a summary of the practical applications of the test, see Welsh and Chapman, *Aust. Med. Gaz.*, 1907, p.1.

† *Zeit. f. biol. Meth. und Tech.* L., p.201, 1908.

## REVISION OF AUSTRALIAN LEPIDOPTERA, V.

BY A. J. TURNER, M.D., F.E.S.

Fam. GEOMETRIDÆ.

Subfam. GEOMETRINÆ.

Forewings with 7, 8, 9 stalked, 10 usually stalked with them, their common stalk arising from upper angle of cell, 6 nearly always approximated or stalked with them, 11 usually separate, rarely stalked, either free or anastomosing shortly with 12 and 10, or with 12 only, no areole. Hindwings with 5 strongly approximated to 6 at origin, 8 approximated to cell near base, diverging at or before middle, or rarely approximated to beyond middle. Frenulum and retinaculum frequently rudimentary or absent, being replaced by a rounded costal dilatation of base of hindwing.

The *Geometrinæ* form a very natural group. The *Acidalianæ* (or *Sterrhinæ*) are usually, though not always, distinguishable by the origin of vein 5 of the hindwings. But independently of this, the structure of the forewings is fundamentally different in the two subfamilies. In the *Acidalianæ*, veins 11 and 10 arise by a common stem, which anastomoses with the common stem of 7, 8, 9, forming the areole. Those genera in which the areole is absent, have been developed from genera in which that structure exists, by the gradual obliteration of the areole by fusion of its walls. In the *Geometrinæ*, on the other hand, an areole is never developed;\* vein 11 is either free, or very frequently anastomoses first with 12 and then with 10, or it may anastomose with 12

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\* My attention was called to this point by Hampson's "Moths of India," ill., p.496; but Mr. Prout informs me that the absence of an areole in this group was first insisted on by Lederer.

only. As a rare abnormality the anastomosis with 12 may be missed, while that with 10 is present, but 10 arises always separately from 11, and usually from the stalk of 7, 8, 9, and this is fundamentally different from the normal structure of the *Acidalianæ*. Another radical distinction is, that the common stalk of 7, 8, 9 arises, in the *Acidalianæ*, from well before the upper angle of the cell, widely separate from 6, which arises at the angle. In the *Geometrinæ* the common stalk arises from the angle, and 6 is usually either closely approximated to or stalked with it; though, in rare instances, the origin of 6 is displaced downwards. From these considerations it follows that the *Acidalianæ* are not derived from the *Geometrinæ*, as I formerly supposed, but are a collateral and independent line of development.

The more primitive genera of the *Geometrinæ* differ from the remainder of the group in two characters. Firstly, in the separate origin of vein 10 of the forewings from the cell, a character present in the genera *Protophyta*, *Heliomystis*, *Rhuma*, and *Sterictopsis*. Secondly, in the close approximation of vein 8 of the hindwings to well beyond the middle of the cell, a character found in *Protophyta*, *Heliomystis*, *Rhuma*, and *Oenochlora*. The first of these characters is not uncommon in the *Monoctenianæ* (*Oenochrominæ*), while the second is characteristic of that group. If we endeavour to distinguish the two subfamilies by the point of origin of vein 5 of the hindwings, we find that this is not a distinction to be relied on absolutely. Vein 5 of the hindwings usually arises in the *Monoctenianæ* rather nearer to 6 than to 4, and in the genus *Cernia* the approximation is quite as strong as in many *Geometrinæ*. In a genus closely allied to *Sarcinodes*, which I have from Northern Queensland, the approximation is even stronger, 5 and 6 being almost connate; while in the Indian genus *Sarcinodes* (Hmps., *Moths Ind.*, iii., p.315) 5 and 6 are stalked. Though I am unable, at present, to separate the two subfamilies by any absolute definition, I consider them genetically distinct. The two genera I have mentioned are not, in my opinion, genetically allied in any close degree to the parent-stem of the *Geometrinæ*. This group certainly arose out of the *Monoc-*

*tenianae*, and I regard *Eumalea* as the genus, of all with which I am acquainted, coming nearest to the parent-stem of the former subfamily, being a somewhat aberrant branch from this stem. The importance of the approximation of 5 and 6 of the hindwings in the *Geometrinæ* does not consist in that character being peculiar to the subfamily, for it occurs occasionally, as an aberrant character, in some of the other subfamilies; but in the fact that, in the former, that character has become *fixed*, being found without exception throughout the group.

A most important character of the higher *Lepidoptera*, that is all except the primitive *Micropterygidae* and *Hepialidae*, is the presence of a frenulum. In certain groups the frenulum has been lost, and in them its place is supplied by an expansion of the base of the costa of the hindwing. In the *Geometrinæ* may be found all gradations between a strong functioning frenulum and its complete absence. In the lower genera it is well-developed. The first stage in its obsolescence is the appearance of a rounded dilatation of the base of the costa of the hindwing, just beyond the origin of the frenulum. This is soon followed by the obsolescence of the frenulum itself, which usually occurs most rapidly in the female sex. In the male it is longer persistent, but becomes weak and slender; while the retinaculum shifts to nearer the base of the forewing. Evidently, though developed, these organs are not strongly functioning. In the next stage, frenulum and retinaculum become completely obsolete in both sexes. By the use of these characters, the *Geometrinæ* may be readily divided into three divisions, the genera which may be regarded as intermediate being extremely few, at least in the Australian fauna.

Div. i.—Hindwing with a strong rounded dilatation at base of costa. Frenulum and retinaculum completely absent in both sexes.

Div. ii.—Hindwing with a rounded dilatation, usually strongly marked, at base of costa. Frenulum in ♂ usually weak, retinaculum usually close to base of forewing. Frenulum in female usually absent.

In the genus *Apodasmia*, however, the frenulum is represented in the ♀ by a strong tuft of long hairs. In *Chrysochloroma* the costal dilatation is only moderate, and the ♂ frenulum is strong, while that of the ♀ is nearly obsolete.

Div. iii.—Hindwing without basal costal dilatation. Frenulum in ♂ strong, in ♀ represented by a strong tuft of long hairs.

From this last group we may separate

Div. iv.—Forewings with vein 10 arising separately from cell.

Though these divisions are natural, they do not in every instance represent genetic groups. I recognise at least three different lines of ascent between the second and first divisions. This appears of special interest as an example of a tendency, within a group, to develop in a certain direction, whether the tendency be regarded as innate, or as the effect of environment. Between the third and second divisions there does not seem, in the Australian genera, any necessity to assume more than a single stem.

Much caution and the examination of a large amount of material are necessary before basing the generic definitions, in this group, on variations in the neurulation. The variations in vein 11, for instance, may not infrequently be found all to occur within the same species. Other examples of variability will be given in this paper. The stalking or separation of veins 6 and 7 of the hindwing is, on the other hand, very constant; I have, so far, observed only one exception, in the genus *Uliocnemis*, though the examination of larger material may show others. Differences in the shape of the cell, more especially of the discocellulars, sometimes afford valuable characters, as in the genera *Comostola*, *Argyrocosma*, and *Thalassodes*. The shape of the hindwings is sometimes a reliable generic character, but its right application calls for discrimination. The variations in the length of the palpi in both sexes frequently mark out natural genera, but in the more primitive genus *Terpna* they do not seem to have attained fixity, and are, I think, of specific value only. Variations in the antennæ of either sex give good characters in

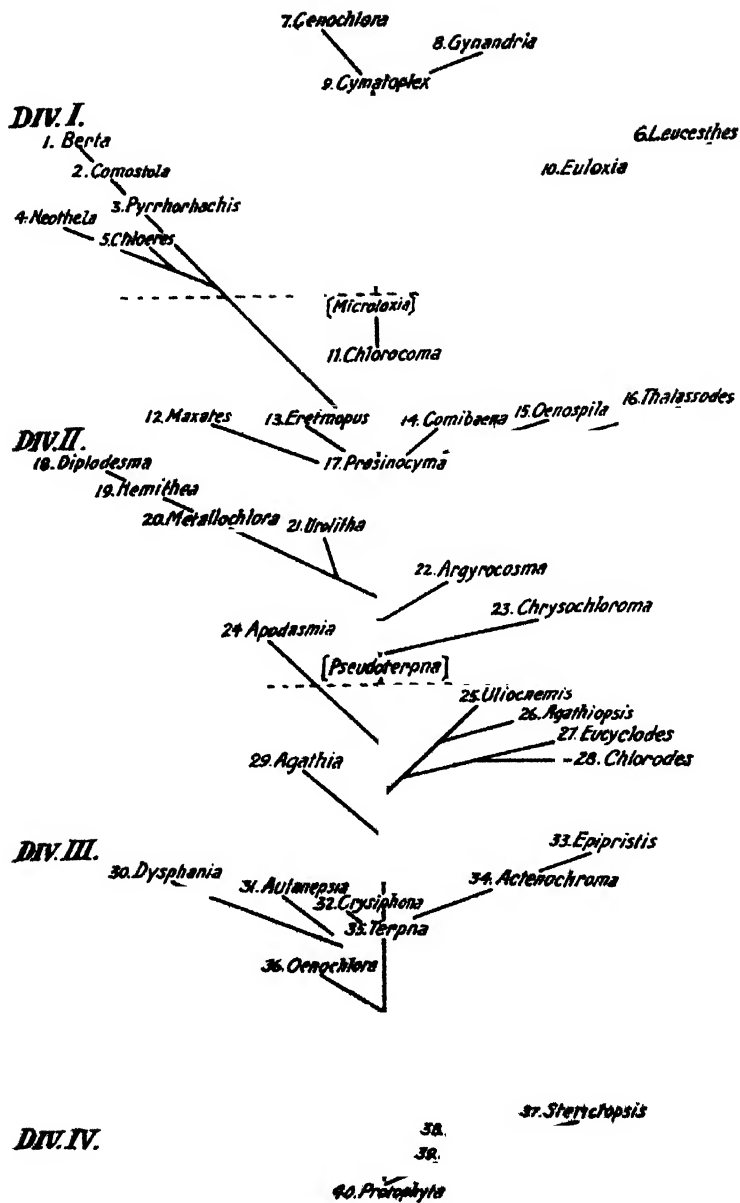
this group, though in other families of Lepidoptera they may be less reliable; the ciliated male antennæ of the *Hemithea*-group, for instance, separate this group of genera sharply from its allies.

For our knowledge of the Australian species we are mainly indebted to one of Mr. Meyrick's valuable papers (Proc. Linn. Soc. N. S. Wales, 1887, p. 835), which will always remain classical. Since its publication the number of known species has been much increased, especially from the northern part of the continent; and a more minute study of certain details of structure has necessitated considerable generic alterations, without, however, in any way affecting the characteristic accuracy of Mr. Meyrick's work. Sir Geo. Hampson's "Moths of India" contains some valuable information regarding structural points. Mr. Warren's papers in the "Novitates Zoologicae" are indispensable for reference, but must be used with caution. To Mr. L. B. Prout, who has lately undertaken an examination of this subfamily for the "Genera Insectorum," I am much indebted for information regarding some exotic genera, and for the right understanding of the genera *Comostola* and *Leucesthes*; also for sending me types of some of the Hübnerian genera. As my tabulation of the genera is necessarily, to some extent, artificial, I have attempted to illustrate their natural relationships by means of a "genealogical tree." Such a device, though useful, can be at best no more than a rough approximation to the truth; and a knowledge of the exotic genera, which I do not possess, would probably entail considerable modification.

Following Mr. Meyrick, the lengths of the palpi are expressed in terms of the breadth of the eye, the lengths of their terminal joints in terms of the second joint, and that of the antennal pectinations or ciliations in terms of the breadth of the antennal stalk. The numerals following records of locality refer to the months of capture. A † is attached to the names of species, whose structure I have not been able to examine.

I am, as usual, much indebted to Mr. Geo. Lyell for the loan of specimens from his extensive collection, and for many locality-references.





*Tabulation of Genera.*

- A. Hindwings with a rounded costal expansion at base beyond point of origin of frenulum.
- B. Frenulum and retinaculum absent in both sexes.
- C. Palpi 1 or less, terminal joint minute in both sexes.
- D. Posterior tibiae without middle spurs.
- E. Tongue absent, palpi minute..... 7. CENOCHLORA.
- EE. Tongue present, palpi short but well developed.
- F. Antennae pectinated in both sexes .... 8. GYNANDRIA.
- FF. Antennae pectinated in ♂, simple in ♀..... 9. CYNATOPLEX.
- DD. Posterior tibiae with middle spurs.
- E. Forewings with 10 anastomosing with 9. 6. LEUCESTRES.
- EE. Forewings with 10 not anastomosing with 9..... 10. EULOXIA
- CC. Palpi over 1, terminal joint rather long, at least in ♀.
- D. Forewings with discocellulars separate on vein 5, dorsal arising posteriorly to costal.
- E. Hindwings dentate, with a strong projection on vein 4..... 1. BERTA.
- EE. Hindwings not dentate, rounded or angled on vein 4, not projecting..... 2. COMOSTOLA.
- DD. Forewings with discocellulars not separate on vein 5.
- E. Hindwings markedly elongate..... 3. PYRRHORNACHIS.
- EE. Hindwings not elongate.
- F. Both wings with 3 and 4 widely separate at origin.... 4. NEOTHELA.
- FF. Both wings with 3 and 4 approximated, connate, or stalked..... 5. CHLOERES.
- BB. Frenulum in ♂ present but nearly always weak, retinaculum nearly always close to base of forewing, frenulum in ♀ usually absent.
- C. Palpi 1 or less, terminal joint minute in both sexes... 11. CHLOROCOMA.
- CC. Palpi 1 or more, terminal joint more or less elongate, at least in ♀.
- D. Antennae in ♂ pectinate.

- E. Hindwings with costal edge of cell considerably over  $\frac{3}{4}$  of dorsal edge.
- F. Frenulum in ♂ strong..... 24. *CHRYSOCHLOROM.*
- FF. Frenulum in ♂ slender.
- G. Hindwings quadrate, acutely angled and strongly produced on vein 4... 12. *MAXATES.*
- GG. Hindwings not quadrate.
- H. Posterior tibiae of ♂ aborted, without spurs..... 18. *EBETMOPUS.*
- HH. Posterior tibiae of ♂ not aborted.
- J. Posterior tibiae of ♂ with a long slender terminal process about  $\frac{1}{2}$  length of tarsus..... 14. *COMIBÆNA.*
- JJ. Posterior tibiae of ♂ with terminal process short or absent.
- K. Posterior tibiae of ♂ with terminal spurs absent..... 15. *OENOSPILA.*
- KK. Posterior tibiae of ♂ with all spurs present..... 17. *PRASINOCYMA.*
- EE. Hindwings with costal edge of cell about  $\frac{3}{4}$  of dorsal edge.
- F. Hindwings with discocellulars not widely separate on vein 5, 3 and 4 stalked..... 16. *THALASSODES.*
- FF. Hindwings with discocellulars widely separate on vein 5, 3 and 4 remote at origin..... 22. *ARGYROCOSMA.*
- DD. Antennæ in ♂ ciliate.
- E. Hindwings with 6 and 7 stalked.
- F. Forewings with 11 and 10 arising out of 9 and running into 12..... 18. *DIPLODESMA.*
- FF. Forewings with 11 from cell, 10 not running into 12.
- G. Posterior tibiae of ♂ without middle spurs..... 19. *HEMITHEA.*
- GG. Posterior tibiae of ♂ with middle spurs.
- H. Hindwings angled or produced on vein 4, not produced at tornus... 20. *METALLOCHLORA.*
- HH. Hindwings with termen straight and long, and with a rounded projection at tornus..... 21. *UROLITHA.*
- EE. Hindwings with 6 and 7 separate..... 23. *APODASMA.*

- AA. Hindwings without costal expansion at base, frenulum and retinaculum in ♂ well-developed, frenulum in ♀ usually represented by a long tuft of hairs.
- B. Forewings with vein 10 stalked with 7, 8, 9.
- C. Thorax with a strong posterior crest.
- D. Posterior tibiae without middle spurs..... 25. ULICONEMIN.
- DD. Posterior tibiae with middle spurs..... 26. AGATHIOPSIS.
- CC. Thorax not crested.
- D. Hindwings with 6 and 7 stalked.
- E. Hindwings with costal edge of cell about  $\frac{3}{4}$  length of dorsal edge. .... 27. EUCYCLODES.
- EE. Hindwings with costal edge of cell considerably exceeding  $\frac{3}{4}$ ..... 28. CHLORODES.
- DD. Hindwings with 6 and 7 separate or rarely connate.
- E. Hindwings with termen strongly produced on vein 4..... 29. AGATHIA.
- EE. Hindwings with termen rounded.
- F. Antennae pectinated in both sexes, in ♂ to apex..... 30. DYSPLANIA.
- FF. Antennae in ♀ simple, in ♂ with apical  $\frac{1}{2}$  simple.
- G. Forewings with vein 6 arising near 5, remote from 7..... 31. ACTANEPSIA.
- GG. Forewings with vein 6 closely approximated or connate with 7.
- H. Posterior tibiae without middle spurs..... 32. CRYPTISIPMONA.
- HH. Posterior tibiae with middle spurs.
- J. Antennae in ♂ ciliate.
- K. Thorax smooth or only slightly hairy beneath..... 33. EPIPRISTIS.
- KK. Thorax very densely hairy beneath..... 34. ACTENOCHROMA.
- JJ. Antennae in ♂ pectinate.
- K. Hindwings with 8 diverging from cell at or before middle 35. TERPNA.
- KK. Hindwings with 8 closely approximated to cell to well beyond middle..... 36. OENOCHLORA.
- BB. Forewings with vein 10 arising separately from cell.

## C. Thorax and abdomen crested.

D. Hindwings with 6 and 7 stalked..... 37. STERICTOPSIS.

DD. Hindwings with 6 and 7 separate.

E. Antennæ of ♂ ciliate..... 38. RHUMA.

EE. Antennæ in ♂ pectinate..... 39. HELIOMYSTIS.

CC. Thorax and abdomen not crested..... 40. PROTOPHYTA.

## Gen. I. BERTA.

*Berta*, Wlk., Cat. Brit. Mus. xxvi. p. 1621.

Face smooth. Tongue well-developed. Palpi slender, porrect, moderate in ♂, rather long in ♀; second and terminal joints smooth-scaled; terminal joint in ♂  $\frac{1}{2}$ , in ♀  $\frac{2}{3}$ . Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax not hairy beneath. Posterior tibiae with all spurs present; in ♂ dilated with a long tuft of hairs lying in a groove on inner surface, terminal spurs shortened, and a short stout terminal process. Hindwings elongate, terminal dentate with a strong projection on vein 4; a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 connate or slightly separate, 6 connate, 11 stalked with 7, 8, 9, 10 beyond 6 and anastomosing with 12; discocellulars separate on vein 5, dorsal arising posteriorly to costal. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 approximated to cell near base and rapidly diverging; discocellulars moderately oblique, slightly angled or nearly straight on vein 5, costal edge of cell considerably over  $\frac{2}{3}$ .

Differing from *Comostola* only in the shape of the hindwings. Type, *Berta chrysolineata* Wlk.

## 1. BERTA CHRYSOLINEATA.

*Berta chrysolineata* Wlk., Cat. Brit. Mus. xxvi. p. 1621; Moore, Lep. Ceyl. iii. p. 435, Pl. 196, f. 4; Hmps., Moths Ind. iii. p. 516.

*Euchloria leucospilota* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 221.

N.A.: Port Darwin, 1, 12.—N.Q.: Kuranda, 3, 4. Also from Ceylon and India.

## Gen. 2. COMOSTOLA.

*Comostola* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 869.

Face smooth. Tongue well-developed. Palpi slender, porrect, in ♂ moderate, or rather long, in ♀ long; second and terminal joints smooth-scaled; terminal joint usually short in ♂, always elongate in ♀. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax not hairy beneath. Posterior tibiæ with all spurs present; in ♂ dilated, with terminal spurs shortened, and a tuft of long hairs on inner side, sometimes with a short stout terminal process. Hindwings with termen rounded or slightly angled on vein 4, not projecting; a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 stalked or connate, 6 separate or short-stalked, 11 arising from cell or stalked with 7, 8, 9, 10 beyond 6, not anastomosing; discocellulars separate or widely separate on vein 5, dorsal arising posteriorly to costal. Hindwings elongate; with 3 and 4 stalked, 6 and 7 stalked; 8 connected with cell at a point near base and rapidly diverging; discocellulars nearly straight, slightly oblique, dorsal sometimes curved so as to be more oblique; costal edge of cell considerably over  $\frac{2}{3}$ .

Type, *Iodis lasaria* Wlk. The structure of the cell of the forewings, together with the elongate hindwings, which may have the termen either strongly rounded, or slightly angled on vein 4, but never projecting, are the distinguishing marks of this genus. The separation of the discocellulars of the forewings, sometimes slight, becomes very pronounced in *C. lasaria* and *C. nersidaria*. Vein 11 may either arise free from the cell, as in most *Geometrinæ*; or may be stalked with 7, 8, 9, 10 well beyond 6. In view of the close specific relationship of *C. subtilaria* Brem., from Eastern Asia, which has the former structure, with *C. lasaria*, I do not think the difference can be made use of for generic subdivision.

1. Hindwings obtusely angled on vein 4. ....	2.
Hindwings rounded.....	5.

- |  |                         |
|--|-------------------------|
| 2. Wings with numerous discal spots edged with pale ochreous .....       | 3.                      |
| Only one discal spot in each wing, not edged with pale ochreous .....    | 4.                      |
| 3. Head with dark red transverse line, costal edge of cell $\frac{2}{3}$ | 2. <i>lesaria</i> .     |
| Head without dark red line, costal edge of cell $\frac{1}{2}$ .....      | 8. <i>nereidaria</i> .  |
| 4. Discal spot of hindwings large, with leaden-metallic scales.....      | 4. <i>leucomerata</i> . |
| Discal spot of hindwings small, without leaden-metallic scales.....      | 5. <i>haplophanes</i> . |
| 5. Wings edged with white.....   | 6. <i>chlorargyra</i> . |
| Wings interruptedly edged with fuscous-red.....                          | 7. <i>eucraspedu</i> .  |

### 2. COMOSTOLA LÆSARIA.

*Iodis læsaria* Wlk., Cat. Brit. Mus. xxii. p.544; *Eucrostis perlepidaria* Wlk., Cat. Brit. Mus. xxxv. p.1610; *Comibæna maculata* Moore, Proc. Zool. Soc. 1867, p.638; *Comostola perlepidaria* Meyr., Proc. Linn. Soc. N. S. Wales 1887, p.869.

Frons green, with a narrow transverse dark red line anteriorly; fillet broadly white. Palpi in ♂ 2, terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{2}$  terminal joint  $\frac{3}{4}$ . Forewings with costal edge of cell  $\frac{2}{3}$  dorsal; veins 3 and 4 stalked or connate, 11 stalked with 7, 8, 9, 10 beyond 6; two fuscous costal dots representing origin of first and second lines; second line represented by a well-developed series of spots. Hindwings with 3 and 4 stalked. Posterior tibiae of ♂ dilated, with tuft of hairs, shortened terminal spurs, and very short stout terminal process.

N.A.: Port Darwin, 9, 10—Q.: Brisbane, 1, 2, 3, 4, 5, 11, 12, Southport. Also from Ceylon and India.

### 3. COMOSTOLA NEREIDARIA.

*Comostola nereidaria* Snel. ; *Comostola flavicincta* Warr., Nov. Zool. 1896, p.288.

Frons narrowly green posteriorly, anteriorly yellow-ochreous, which colour is suffused over fillet, either wholly or leaving its anterior edge white. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{2}$ , terminal joint  $\frac{3}{4}$ . *C. meritaria*, Wlk., which is very similar, differs in neuration. Forewings with costal edge of cell  $\frac{1}{2}$

dorsal; 3 and 4 connate, 11 stalked with 7, 8, 9, 10 beyond 6; darker green than in *C. lasaria*, all spots smaller except the discal which appear disproportionately large; no fuscous costal dots. Hindwings with 3 and 4 stalked. Posterior tibiae of ♂ dilated, but terminal spurs not abbreviated, and without terminal process.

N.Q.: Kuranda, 4; Geraldton, 11. Also from Louisiades and Celebes.

#### 4. *COMOSTOLA LEUCOMERATA*.

*Chlorochroma leucomerata* Wlk., Cat. Brit. Mus. xxxv. p. 1609; *Iodis leucomerata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 889.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{2}$ , terminal joint 1. Forewings with 3 and 4 stalked or connate, 11 from cell. Hindwings with 3 and 4 stalked. The discal spots on both wings are sometimes white in the centre. Posterior tibiae of ♂ dilated, with tuft of hairs, shortened terminal spurs, and very short stout terminal process.

N.Q.: Kuranda—Q.: Brisbane, 12; Mt. Tambourine, 2. Also from New South Wales, according to Mr. Meyrick.

#### 5. *COMOSTOLA HAPLOPHANES*, n.sp. [*ἀπλοφάνης*, of simple appearance].

♂. 23 mm. Head green; fillet snow-white; face ferruginous, lower edge green-whitish. Palpi whitish, external surface of second joint ferruginous; in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Antennae white; pectinations in ♂ 10-12. Thorax and abdomen green, sides and undersurface whitish; legs whitish, anterior pair, except coxae, fuscous anteriorly; posterior tibiae of ♂ dilated with internal groove and tuft, and abbreviated terminal spurs. Forewings triangular, costa nearly straight, strongly arched near base, less so towards apex, apex round-pointed, termen straight, oblique; 3 and 4 connate, 6 short-stalked, 11 from cell; bright green; costal edge yellowish; a small dark ferruginous discal spot; an obscure, dark green, markedly dentate, postmedian line; cilia pale yellow, with a narrow, interrupted, dark ferruginous basal line, best



marked at apex. Hindwings with termen obtusely angled on vein 4; 3 and 4 stalked; colour and markings as forewings. Underside whitish. Type in Coll. Lyell.

N.Q.: Kuranda, in May; one specimen, received from Mr. F. P. Dodd.

#### 6. *COMOSTOLA CHLORARGYRA*.

*Comibæna chlorargyra* Wlk., Cat. Brit. Mus. xxii., p.577; *Comostola conchylias* Meyr., Trans. Ent. Soc. 1889, p.490.

Mr. Prout informs me that this is distinct from *C. dispansa* Wlk., which has a green abdomen.

Forewings with 3 and 4 separate at origin, 11 from cell. Hindwings with 3 and 4 stalked. I have only one specimen for examination. There may be some considerable variation in markings of forewings. Posterior tibiae of ♂ dilated but without terminal process.

N.Q.: Kuranda, 9,10,3; Townsville, 4,5. Also from New Guinea, Borneo, and Ceylon.

#### 7. *COMOSTOLA EUCRASPEDA*, n.sp. [εὐκράσπεδος, well-bordered].

♀. 24 mm. Head dull red irrorated with blackish, face pale red, fillet narrowly whitish. Palpi whitish; in ♀ 2½, terminal joint ¾. Antennæ red, towards apex whitish. Thorax bright green, small spots on shoulders and a large posterior spot reddish irrorated with blackish. Abdomen whitish, with a median dorsal reddish streak [badly rubbed]. Legs pale reddish; posterior pair except tarsi whitish. Forewings with costa rather strongly arched, [apex broken], termen slightly bowed, oblique; 3 and 4 connate, 6 separate, 11 stalked with 7, 8, 9, 10; bright green; a reddish streak thickly irrorated with blackish along costa and termen; costal portion rather broad, with a dentate internal process at middle; terminal portion fine, dilated into spots at tornus and above middle; [cilia abraded]. Hindwings with termen strongly bowed; 3 and 4 short-stalked; 6 and 7 short-stalked; colour and markings as forewings but without costal streak. Type in Coll. Turner.

N.A.: Port Darwin, in November; one specimen, received from Mr. F. P. Dodd.

## Gen. 3. PYRRHORHACHIS.

*Pyrrhorhachis* Warr., Nov. Zool. 1896, p. 292.

Face smooth. Tongue well developed. Palpi long, slender; terminal joint elongate, especially in ♂. Antennæ in ♂ pectinate, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax not hairy beneath. Posterior tibiæ with all spurs present. Frenulum and retinaculum obsolete in both sexes; hindwings with a strong costal expansion at base. Forewings with 3 and 4 stalked, 11 from cell or stalked with 7, 8, 9, 10 before 6, free or anastomosing with 12; discocellulars not separated on vein 5. Hindwings markedly elongate with termen strongly rounded; 3 and 4 stalked, 6 and 7 stalked, 8 approximated to cell near base discocellulars scarcely angled, but slightly oblique.

Type *Eucrostis pyrrhoga* Wlk. In the shape of the hindwings, this agrees with *Comostola chlorargyra*, but differs in the form of the cell of the forewings. I regard the genus as ancestral to *Comostola*.

## 8. PYRRHORHACHIS PYRRHOGONA.

*Eucrostis pyrrhoga* Wlk., Cat. Brit. Mus. xxxv., p. 1610; *Iolus marginata* Luc., Proc. Linn. Soc. N. S. Wales 1888, p. 1268; *Comostola pyrrhoga* Meyr., Trans. Ent. Soc. 1889, p. 491; *Euchloris pyrrhoga* Hmps., Moths Ind. iii., p. 500; *Pyrrhorhachis cornuta*, Warr., Nov. Zool. 1896, p. 292.

The only Australian species which can be described as blue. There may be a reddish discal spot on each wing margined with ochreous, and containing a few blackish scales, or discal spots may be completely absent. Palpi in ♀ 2, terminal joint  $\frac{3}{2}$ . I have not examined a male.

N.A.: Port Darwin, 9, 10, 12—N.Q.: Thursday Island; Kuranda, 4, 5, 10—Q.: Brisbane, 12. Also from New Guinea, Ceylon, and India.

Gen. 4. NEOTHELA, n.g. [*νέοθελος*, freshly green.]

Head smooth. Tongue well-developed. Palpi slender, porrect, rough-haired beneath towards base; terminal joint in ♂

minute; [in ♀ probably longer]. Antennæ in ♂ pectinated, apices simple. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiæ with all spurs present; in ♂ strongly dilated, with a groove containing a tuft of hair on inner side. Hindwings with a strong costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 widely separate at base, 6 separate, 11 from cell, anastomosing first with 12 and then with 10. Hindwings with 3 and 4 widely separate at base, 6 and 7 stalked, 8 closely approximated to cell near base, thence diverging; discocellulars slightly angled on vein 5, dorsal strongly curved so as to become very strongly oblique, costal edge of cell considerably exceeding  $\frac{3}{4}$ .

Type *N. cissochroa* Turn. This genus differs from *Chloëres* in the wide separation of veins 3 and 4 of both wings.

9. *NEOTHELA CISSOCHROA*, n.sp. [*κισσοχροα*, ivy-green.]

♂. 24 mm. Head bluish-green; fillet snow-white; face green. Palpi in ♂  $1\frac{1}{2}$ ; whitish, tinged with green above. Antennæ white; pectinations in ♂, outer row 7, inner row 5. Thorax bluish-green. Abdomen bluish-green, apices of segments, tuft, sides, and under-surface white; under-surface of fourth segment in ♂ occupied by a patch of long coarse whitish-ochreous hairs. Forewings triangular, costa moderately arched, apex round-pointed, termen nearly straight, oblique; bluish-green; lines very slender, white; first at  $\frac{1}{4}$ , obtusely toothed outwardly beneath middle; second at  $\frac{3}{4}$ , finely denticulate; a slender white circle above middle; cilia green. Hindwings with termen bowed on vein 4; colour, discal circle, postmedian line, and cilia as forewings. Type (unfortunately in poor condition) in Coll. Turner.

N.Q.: Townsville, in September; one specimen, received from Mr. F. P. Dodd.

Gen. 5. *CHLOERES*, n.g. [*χλωερης*, green.]

Face smooth. Tongue well developed. Palpi slender; in ♂ short or moderate, with minute terminal joint; in ♀

longer, with longer terminal joint. Antennæ in ♂ pectinate, apices simple; in ♀ simple. Posterior tibiæ with all spurs present; in ♂ sometimes dilated. Frenulum and retinaculum obsolete in both sexes; hindwings with a strong rounded expansion at base. Forewings with 3 and 4 slightly separate, connate, or stalked, 11 from cell, not anastomosing. Hindwings with 3 and 4 stalked or connate, 6 and 7 stalked, 8 approximated to cell near base; discocellulars scarcely angled on vein 5, dorsal bent and moderately oblique.

Type, *Chlorochroma citrolimbaria*, Gn. I place this genus low down on the *Comastola*-stem. The relationship to *Euloxia* is, I think, collateral.

#### 10. CHLOERES CITROLIMBARIA.

*Chlorochroma citrolimbaria*, Gn., Lep. ix. p 366; nec Wlk., Cat. Brit. Mus. xxii. p.562: *Chlorochroma inchoata* Wlk., Cat. Brit. Mus. xxii. p.563; *Iodis inchoata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.881; *Iodis illidgei* Luc., Proc. Linn. Soc. N. S. Wales, 1889, p.603.

♂♀. 22-31 mm. Head green, anteriorly yellow; fillet narrowly white; face reddish, lower edge white. Palpi small, slender; whitish; in ♂ 1, terminal joint  $\frac{1}{2}$ ; in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Antennæ yellow, pectinations and apices whitish. Thorax and abdomen green, a median yellowish dorsal line from midthorax; apical segments, sides, and under surface of abdomen white. Legs white; anterior pair reddish; anterior coxæ white; posterior tibiæ in ♂ not dilated and without terminal process. Forewings triangular, costa nearly straight, apex round-pointed, termen nearly straight, oblique; 3 and 4 usually stalked, sometimes connate, 11 from cell; green; without lines; a narrow yellow costal and terminal streak; cilia yellow. Hindwings with termen but slightly bowed; 3 and 4 stalked or connate, 6 and 7 only short-stalked; colour and cilia as forewings. Underside whitish-green.

N.Q.: Kuranda, 4, 5—Q.: Nambour; Brisbane, 5; Mount Tambourine, 2, 5, 10, 11.

Mr. R. Illidge has reared this species from larvæ feeding on *Duboisia*.

11. *CHLOERES CISSINA* n.sp. [*κίσσινα*, ivy-green.]

♂ 25 mm. Head and face green; fillet and antennæ white. Palpi green; in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{4}$ . Thorax bluish-green. Abdomen bluish-green, tuft, sides, and lower surface white. Legs whitish; anterior femora, tibiæ and tarsi reddish-tinged; anterior coxæ greenish; posterior tibiæ in ♂ dilated, with a tuft of long hairs in a groove on inner side, terminal spurs shortened, and a very short stout terminal process. Forewings triangular, costa moderately arched, apex round-pointed, termen slightly bowed, oblique; 3 and 4 slightly separate at origin, 6 separate, 11 from cell; bluish-green; a whitish dot on dorsum at  $\frac{2}{5}$ , and another on submedian representing first line; a series of faint whitish dots on veins at  $\frac{3}{4}$  representing second line; cilia whitish-green. Hindwings with termen strongly bowed; 3 and 4 connate; as forewings but with no trace of first line. Underside whitish-green.

Q.: Killarney; in October, one specimen.

Type in Coll. Turner.

Gen.6. *LEUCESTHES*.

*Leucesthes* Warr., Nov. Zool. 1902, p.348; *Acibdela* Turn., Trans. Roy. Soc. S. Austr. 1906, p.130.

Face smooth. Tongue well developed. Eyes larger in ♂ than in ♀. Palpi slender, short; in ♂  $\frac{3}{4}$ , in ♀ 1; terminal joint minute in both sexes. Antennæ in ♂ pectinated to near apex, terminal  $\frac{1}{2}$  simple; in ♀ simple. Thorax and abdomen not crested. Posterior tibiæ with all spurs present, rather closely approximated. Hindwings narrower than forewings; with a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 remote at origin, 6 out of 7, 8, 9, opposite or beyond 10; 11 anastomosing with 12 and then with 10; 10 anastomosing or connected with 8+9. Hindwings with 3 and 4 well separated at base; 5 strongly approximated to 6; 6 and 7 stalked, 8 approximated to cell as far as

middle, then gradually diverging; discocellulars angled on vein 5, dorsal curved so as to become rather strongly oblique, costal edge of cell not much shorter than dorsal. Type, *Nearcha alba* Swin.

Mr. L. Prout first pointed out to me that this genus belongs to the *Geometrinae*, and he is certainly correct. The strong approximation of vein 5 of hindwings to 6, the absence of a frenulum, together with the smooth face and anastomoses of vein 11 of forewings are decisive. The exact place among other genera is more difficult to determine. The somewhat long approximation of vein 8 of hindwings to cell, as in the *Monoctenianæ*, may be ancestral, but may also be a recent modification secondary to the narrowed hindwings, and in either case is nearly as well marked in *Euloxia gratosata*. The absence of a frenulum is not likely to be found in a primitive genus. The anastomosis of 10 with 9, the pectinations of antennæ to apex, the narrow wings and the white coloration are peculiar characters, but not of great importance. The genus is one of the peculiar forms of Australia, and does not appear to have any near allies.

#### 12. LEUCESTHES ALBA.

*Nearcha alba* Swin., Ann. Mag. Nat. Hist. (7), ix. p.79(Feb., 1902); *Leucesthes margarita* Warr., Nov. Zool. 1902, p.348(July).

♂♀. 22-24 mm. Head, face, palpi, antennæ, thorax, and abdomen white. Legs whitish. Forewings narrow, triangular, costa slightly arched, apex rounded, termen strongly bowed, strongly oblique; shining white; a suffused whitish-ochreous subcostal streak along veins, and sometimes a narrower streak along median vein; cilia white. Hindwings elongate, narrower than forewings, termen very strongly rounded; shining white; cilia white.

N.W.A.: Rosburne. I have received two specimens, for examination, from Mr. G. Lyell.

#### Gen.7. CENOCHLORA.

*Cenochlora* Warr., Nov. Zool. 1898, p.12.

Face smooth, rounded, not projecting. Tongue absent. Palpi half-aborted, slender, very short, less than  $\frac{1}{2}$ . Antennæ with

long pectinations in both sexes, apices simple. Thorax and abdomen not crested. Thorax not hairy beneath. Posterior tibiae without middle spurs in both sexes. Hindwings with a strong rounded costal expansion at base, frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 remote at origin, 6 separate, 11 connected with 12 on a point only (four specimens examined). Hindwings with 3 and 4 widely remote at origin, 6 and 7 short-stalked or connate, 8 connected with cell at a point near base, then diverging; discocellulars slightly angled on vein 5, dorsal rather strongly oblique; costal edge of cell considerably over  $\frac{3}{4}$ .

Distinguished from the following genus by the absence of tongue, and half-aborted palpi. It also differs in the neurulation. Type *Iodis quieta* Luc.

As *Cenochlora* is one of the best genera that Mr. Warren has characterised, it is surprising that he should have subsequently (Nov. Zool. 1905, p.422) merged it in the equally natural but widely different *Chlorochroma* Gn. There are no less than six points of difference between them, any one of which is sufficient for generic separation.

*Cenochlora* Warr.—(1) Tongue absent. (2) Palpi half-aborted. (3) Antennae with long pectinations in both sexes. (4) Frenulum in ♂ absent. (5) Posterior tibiae without middle spurs in both sexes. (6) Veins 3 and 4 of hindwings widely remote at origin.

*Chlorochroma* Gn.—Tongue present. Palpi well-developed, though short. Antennae in ♀ simple. Frenulum in ♂ present. Middle spurs well developed. Veins 3 and 4 of hindwings closely approximated, connate, or stalked.

- |  |                        |
|--|------------------------|
| 1. Both wings with bases of cilia and discal dots dull reddish | 13. <i>quieta</i> .    |
| Cilia wholly white, no discal dots.....                        | 14. <i>quantilla</i> . |

### 13. CENOCHLORA QUIETA.

*Iodis quieta* Luc., Proc. Roy. Soc. Qld. 1891, p.79; *Cenochlora felix* Warr., Nov. Zool. 1898, p.12.

♂♀. 18-22 mm. Head, face, and palpi green; fillet snow-white. Antennæ white; pectinations in both sexes 10. Thorax and abdomen green, beneath green-whitish; the latter with one or two median white dots on dorsum. Legs green-whitish; anterior pair green. Forewings triangular, costa gently arched, more strongly at base, apex round-pointed, termen bowed, oblique; green; a white costal streak, tinged with ochreous at base; two dentate whitish lines; first from  $\frac{1}{3}$  costa to  $\frac{1}{3}$  dorsum, outwardly curved; second from  $\frac{2}{3}$  costa to  $\frac{2}{3}$  dorsum, nearly straight; a minute dull reddish median discal dot; cilia dull reddish, apices white. Hindwings with termen strongly bowed; colour and markings as forewings, but first line obsolete.

Although I have not seen the type, I think Mr. Warren is correct in his identification (Nov. Zool. 1905, p.422). It is true that the head is reddish-ochreous and the face ochreous in the original description, but some allowance must be made for the inexactness of Dr. Lucas' descriptions.

Q.: Duaringa; Brisbane, 4; Rosewood, 3, 4; Toowoomba, 4; Bunya Mountains, 12. I have four examples, including one ♀, all taken singly.

#### 14. CENOCHLORA QUANTILLA, n.sp.[quantillus, how little!]

♂. 15 mm. Head and face green; fillet snow-white. Palpi whitish. Antennæ white; pectinations 8. Thorax and abdomen green; beneath white. Legs whitish. Forewings triangular, costa gently arched, more strong at base, apex pointed, termen bowed, oblique; green; first line obsolete; a fine whitish dentate line traceable at  $\frac{2}{3}$ ; cilia white. Hindwings with termen strongly bowed; as forewings. Type in Coll. Turner (slightly worn).

N.Q.: Townsville; in April, one specimen, received from Mr. F. P. Dodd.

#### Gen. 8. GYNANDRIA, n.g.

Face smooth, rounded, not prominent. Tongue present but weakly developed. Palpi short, not exceeding 1; second joint



rough-scaled; terminal joint minute in both sexes. Antennæ bipectinate in both sexes, apices simple. Thorax and abdomen not crested. Thorax slightly hairy beneath. Posterior tibiae without middle spurs in both sexes. Hindwing with a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with vein 6 out of 7 (this is probably not a constant character), 11 usually anastomosing with 12, but sometimes separate. Hindwings with 3 and 4 usually stalked, sometimes connate, 6 and 7 stalked, 8 anastomosing shortly with cell near base, then rapidly diverging; discocellulars angled on vein 5, dorsal strongly oblique; costal edge of cell considerably over  $\frac{3}{4}$ .

Type, *Geometra latilineata* Wlk. I do not know whether there are any other species. This and the preceding genus differ from *Cymatoplex* in the pectination of the ♀ antennæ, a character which is found also in the unrelated genera *Utiocnemis* and *Dysphania*.

#### 15. GYNANDRIA LATILINEATA.

*Geometra latilineata* Wlk., Cat. Brit. Mus. xxxv. p.1605; *Eucrostis latilineata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.868.

A pretty and abundant species, of a bright bluish-green colour when fresh but rapidly fading. The antennal pectinations are rather short (♂ 2, ♀ 1). Northern specimens are smaller, with broader lines; in southern specimens the lines are finer, and the anterior line of forewings may be absent.

N.A.: Port Darwin, 1, 10, 11—N.Q.: Kuranda, 2; Townsville—Q.: Duaringa; Maryborough; Gympie; Nambour, 11, 12; Brisbane, 1, 2, 3, 9, 12; Stradbroke Island; Mt. Tambourine; Rosewood, 3; Nanango; Dalby, 12; Miles—N.S.W.: Tenterfield, 2.

Gen.9. CYMATOPLEX, n.g. [*κυματοπλεξ*, wave-beaten.]

Face smooth, rounded, not projecting. Palpi slender, short, not exceeding 1; terminal joint small in both sexes. Tongue present, rather weak. Antennæ pectinate in ♂, apex simple; in

♀ thick and slightly serrate. Thorax and abdomen not crested. Thorax slightly hairy beneath. Posterior tibiae without middle spurs in both sexes. Hindwings with a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 separate or connate, 6 stalked or separate, 11 free or anastomosing with 12. Hindwings with 3 and 4 separate or connate, 6 and 7 stalked, 8 connected with cell near base, then rapidly diverging, discocellulars slightly angled on vein 5, dorsal moderately oblique, costal edge of cell considerably over  $\frac{3}{4}$ , cell one-half length of wing or more. Type *Iodis crenulata*, Luc.

I have not noticed 3 and 4 of the hindwings to be stalked, but this may occur in the genus.

*Microloxia*, Warr., differs from this genus by the presence of a weak frenulum in the ♂, and forms a connecting link between it and *Chlorocoma*. The European *Eucrotes*, Hb. (type *E. indigenata*, Vill.) differs in the elongate hindwings, with short cell (about  $\frac{2}{3}$ ), and long stalking of 3 and 4, also in 11 of forewings running into 12.

#### 16. CYMATOPLEX CRENULATA.

*Iodis crenulata* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p. 294; *Euchloris dichroa* Low., Trans. R. Soc. S. Austr. 1903, p. 217; *Chlorochroma imparicornis* Warr., Nov. Zool. 1905, p. 422.

♂♀. 17-29 mm. Head pale ochreous; face deep ochreous; fillet snow-white. Palpi and antennae white; pectinations in ♂, outer row 12, inner 8. Thorax and abdomen pale green. Legs white, ochreous-tinged. Forewings triangular, costa nearly straight, apex round-pointed, termen slightly bowed, oblique; pale green, with five or six parallel wavy or dentate transverse whitish lines; a white costal streak with an ochreous streak immediately beneath, in ♀ costal edge ochreous; cilia whitish, sometimes ochreous-tinged. Hindwings with termen bowed; as forewings.

A coastal species. Southern examples are rather larger than northern.

N.A.: Port Darwin, 12—N.Q.: Thursday Island; Townsville, 4, 5, 6, 12—Q.: Brisbane; Stradbroke Island; Southport, 2.

17. CYMATOPLEX HYPOLICHNA, n.sp. [*ὑπολίχνης*, somewhat dainty.]

♂. 17 mm. Head and face ochreous; fillet snow-white. Palpi whitish-ochreous. Antennæ white, undersurface ochreous; pectinations 8. Thorax green. Abdomen green, apical segments and underside white. Legs white; anterior coxæ green. Forewings triangular, costa slightly arched, apex pointed, termen slightly bowed, oblique; an ochreous streak along costa; costal edge white except towards base; two faint whitish wavy transverse lines; first from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum; second from  $\frac{3}{4}$  costa to  $\frac{3}{4}$  dorsum; cilia whitish-ochreous. Hindwings with termen bowed; as forewings. Type in Coll. Turner.

N.A.: Port Darwin, in October; one specimen, received from Mr. F. P. Dodd.

## 18. †CYMATOPLEX ARGOCRANA.

*Eucrostis argocrana* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.867.

Vic.:—

## 19. †CYMATOPLEX IOCENTRA.

*Eucrostis iocentra* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.868.

Q.: Duaringa.

## Gen.10. EULOXIA.

*Euloxia* Warr., Nov. Zool. 1894, p.390.

Face smooth. Tongue well developed. Palpi short, not exceeding 1, second joint hairy beneath, terminal joint minute in both sexes. Antennæ in ♂ with long pectinations, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax only slightly hairy beneath. Posterior tibiae with all spurs developed in both sexes. Hindwings with a strong rounded costal expansion at base; frenulum and retinaculum obsolete in both sexes. Forewings with 3 and 4 separate, 6 separate or short-stalked, 11 anastomosing first with 12, then with 10, or rarely with 12 only. Hindwings with 3 and 4 separate, connate, or short-stalked, 6 and 7 stalked, 8 closely approximated to cell

for some distance, gradually diverging before or at middle; discocellulars slightly angled on vein 5, dorsal slightly or moderately oblique, costal edge considerably over  $\frac{3}{4}$ . Type *Iodis fugitivaria* Gn.

A very natural genus, distinguished from *Chlorocoma* by the absence of a frenulum in the ♂. *Euloxia* is closely allied to *Euchloris* Hb., (type *smaragdaria* Fabr.) which differs in the longer palpi ( $1\frac{1}{2}$  or more), with second joint thickened with dense hairs above and beneath.

*Iodis* Hb., (type *I. chrysoprasaria* Esp. = *vernaria* Hb., nec Linn.) is still more closely allied, but the short palpi are smooth, not rough-haired, beneath, and the ♀ antennæ are shortly pectinated.

- |   |                           |
|---|---------------------------|
| 1. Fillet deep ochreous-yellow .....  | 2.                        |
| Fillet white or whitish .....   | 3.                        |
| 2. Hindwings ochreous-yellow .....  | 20. <i>gratiosata</i> .   |
| Hindwings green-whitish .....   | 21. <i>meandrararia</i> . |
| 3. Forewings with oblique whitish postmedian line .....                             | 4.                        |
| Forewings without postmedian line .....   | 7.                        |
| 4. Face brown or ochreous .....   | 5.                        |
| Face green .....  | 6.                        |
| 5. Forewings with postmedian line nearly straight, not dentate .....                | 22. <i>fugitivaria</i> .  |
| Forewings with postmedian line sinuate and finely dentate .....                     | 23. <i>isadelpa</i> .     |
| 6. Forewings with lines narrow, antemedian line bent inwards in disc. ....          | 24. <i>leucochorda</i> .  |
| Forewings with postmedian line thickened, antemedian not bent inwards in disc. .... | 25. <i>hypsihrona</i> .   |
| 7. Crown of head green .....  | 26. <i>tochthaula</i> .   |
| Crown of head orange with two green dots. ....                                      | 27. <i>teryllina</i> .    |
| Crown of head wholly orange-ochreous .....  | 28. <i>pyropa</i> .       |

## 20. EULOXIA GRATIOSATA.

*Nemoria gratiosata* Gn., Lep. ix. p.351, Pl.xvii. f.1; *Iodis gratiosata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.876.

This species is exceptional in having vein 8 of hindwings approximated to cell as far as middle.

Tas.: Launceston, 3; Hobart; Strahan, 2—Vic.: Melbourne, Beaconsfield, Apsley; Gisborne, 3.

## 21. EULOXIA MEANDRARIA.

*Iodis meandrararia* Gn., Lep. ix. p.355; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.874.

Vic.: Gisborne, 1, 2, 12; Moe.—Tas.: Hobart.

## 22. EULOXIA FUGITIVARIA.

*Iodis fugitivaria* Gn., Lep. ix. p.354; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.876; *Iodis intacta* Wlk., Cat. Brit. Mus. xxii. p.545; *Iodis obliquissima* Wlk., Cat. Brit. Mus. xxii. p.546.

Q.: Toowoomba, Dalby—N.S.W.: Armidale, 2—Vic.: Melbourne; Gisborne, 11—Tas.: Launceston, 1; Deloraine, 11, 12.

23. EULOXIA ISADELPHA, n.sp. [*ισάδελφος*, like a brother.]

♂. 29 mm. Head green; fillet white; face brown. Palpi green. Antennæ white; pectinations in ♂ 5. Thorax green. Abdomen green on dorsum and undersurface, tuft and sides white. Legs with coxæ and femora green; anterior and middle tibiæ and tarsi grey; posterior tibiæ and tarsi white. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; bluish-green; antemedian line obsolete; a fine postmedian line from beneath  $\frac{1}{2}$  costa, sinuate, finely dentate; cilia bluish-green. Hindwings with termen strongly bowed; pale bluish-green becoming whitish towards costa and base; a fine curved whitish line towards dorsum at  $\frac{3}{4}$ ; cilia bluish-green. Underside pale bluish-green partly suffused with whitish. Type in Coll. Lyell.

Closely allied to *E. fugitivaria*, from which it differs in the differently shaped line on forewings.

W.A.: Waroona, in October; one specimen, received from Mr. G. A. Berthoud.

## 24. EULOXIA LEUCOCHORDA.

*Iodis leucochorda* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.875.

Tas.: Deloraine, 12; Lottah.

25. *EULOXIA HYP SITHRONA*.

*Iodis hypsithrona* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.874.

The only specimen I have been able to examine has vein 11 anastomosing with 12 only, not with 10. This is probably exceptional.

N.S.W.: Mt. Kosciusko, 1.

26. † *EULOXIA OCHTHAULA*.

*Iodis ochthaula*, Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.877.

W.A.: Carnarvon, 10.

27. † *EULOXIA BERYLLINA*.

*Iodis beryllina*, Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.877.

W.A.: Geraldton, 11.

28. *EPLOXIA PYROPA*.

*Iodis pyropa*, Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.878.

In the Victorian specimens I have examined, the dorsal cilia of hindwings are pale green; in the West Australian pale ochreous; otherwise they are identical.

Vic.: Castlemaine, 11; Bendigo, 11—W.A.: Perth, 11; Waroona, 10.

Gen. 11. *CHLOROCOMA*, n.g. [*χλωρόκομος*, green-leaved.]

*Chlorochroma* Gn., Lep. ix. p.365, *nec* Dup.

Face smooth, Tongue well developed. Palpi rather stout, short, 1 or less; terminal joint minute in both sexes. Antennæ in ♂ pectinate, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiae with all spurs present in ♂, dilated, with a tuft of hairs in groove on inner side. Hindwings with a strong rounded costal expansion at base; frenulum in ♂ weak, retinaculum

close to base of forewing; frenulum and retinaculum in ♀ obsolete. Forewings with 3 and 4 separate, 6 short-stalked, 11 anastomosing with 12 and then with 10, or anastomosing with 12 only, or free. Hindwings with 3 and 4 separate, connate, or short-stalked, 6 and 7 stalked, 8 approximated to cell near base, then diverging; discocellulars but slightly angled at vein 5, dorsal slightly or moderately oblique; costal edge of cell considerably over  $\frac{2}{3}$ . Type, *C. dichloraria*, Gn.

A very natural genus, the species being closely inter-related. All the variations in vein 11 of the forewings, and veins 3 and 4 of the hindwings occur within the same species. I regard this genus as arising from *Prasinocyma*; with *Prasinocyma semicrocea*, Wlk., it shows real relationship. In turn it is the parent of *Euloxia*. *Chloëres* I regard as arising from *Prasinocyma* by a separate stem.

1. Face crimson or fuscous-crimson.....	2.
Face deep ochreous.....	10.
Face green.....	12.
2. Crown of head wholly crimson.....	3.
Crown of head green posteriorly.....	5.
3. Hindwings with a fuscous-crimson discal spot.....	29. <i>cadmaria</i> .
Hindwings without discal spot .....	4.
4. Forewings with costal edge and apices of cilia whitish	30. <i>rhodocrocea</i> .
Forewings with costal edge and apices of cilia crimson	31. <i>rhodoloma</i> .
5. Thorax and abdomen with a pale median dorsal line	6.
Thorax and abdomen without dorsal line.....	8.
6. Lines on forewings finely denticulate, cilia crimson	
at apices... ..	32. <i>dichloraria</i> .
Lines on forewings obsolete or not denticulate, cilia	
pale ochreous. ....	7.
7. Veins finely whitish-ochreous.....	33. <i>carenaria</i> .
Veins not outlined with whitish-ochreous.....	34. <i>assimilis</i> .
8. Cilia whitish at apices... ..	35. <i>trimonocyma</i> .
Cilia crimson at apices.....	9.
9. Wings whitish-green, without lines.....	36. <i>thalochlora</i> .
9. Wings deep green, with finely denticulate lines.....	37. <i>externa</i> .
10. Wings with ochreous discal dots ....	38. <i>periphraeta</i> .
Wings without discal dots.....	11.
11. Anterior coxæ deep ochreous.....	39. <i>malocrocea</i> .
Anterior coxæ silvery-white.....	40. <i>targocnemis</i> .

- |  |                         |
|--|-------------------------|
| 12. Wings with ferruginous discal dots.....  | 41. <i>tetraspila</i> . |
| Wings without ferruginous discal spots.....  | 13.                     |
| 13. Forewings without lines.....   | 42. <i>asemania</i> .   |
| Forewings with at least a postmedian line.....                                       | 14.                     |
| 14. Postmedian line of forewings straight, strongly oblique, not reaching costa..... | 43. <i>stereola</i> .   |
| Postmedian line of forewings parallel to termen, finely denticulate or wavy.....     | 15.                     |
| 15. Forewings with a strong white costal streak.....                                 | 45. <i>tachypora</i> .  |
| Forewings with costal edge only ochreous-whitish.....                                | 44. <i>neptunus</i> .   |

# 29. CHLOROCOMA CADMARIA.

*Chlorochroma cadmaria* Gn., Lep. ix. p.365; *Chlorochroma vulnerata* Butl, Ann. Mag. Nat. Hist. (5), ix. p.91, 1882; *Iodis cadmaria* Mayr., Proc. Linn. Soc. N. S. Wales, 1887, p.886.  
 N.S.W.: Sydney, 1, 11, 12; Katoomba, 3, 4; Bathurst—Vic.: Melbourne, Beaconsfield; Gisborne, 11, 12; Beechworth—Tasm.: Hobart—S.A.: Mt. Lofty—W.A.: Waroona, 2.

# 30. CHLOROCOMA RHODOCROSSA.

*Euchloris rhodocrossa* Turn., Trans. Roy. Soc. S. Austr. 1906, p.128.  
 W.A.: Bridgetown, 2.

# 31. CHLOROCOMA RHODOLOMA, n.sp. [ροδολωμος, rosy-edged.]

♀. 24 mm. Crown, face, and palpi crimson; fillet white. Antennae white, towards apex grey. Thorax bluish-green, Abdomen bluish-green(fading to whitish). Legs crimson; posterior pair ochreous-whitish. Forewings triangular, costa only slightly arched, apex round-pointed, termen slightly bowed, slightly oblique; bluish-green; without lines; a crimson streak along costa throughout; termen narrowly whitish; cilia crimson, with obscure fuscous dots opposite veins, on dorsum pale green. Hindwings with termen rather strongly bowed; colour and cilia as forewings. Underside pale green, a crimson costal streak on forewing, cilia crimson with a strong, interrupted, basal, dark fuscous line. Type in Coll. Lyell.  
 W.A.: Waroona; in April; one specimen, received from Mr. G. A. Berthoud.



## 32. CHLOROCOMA DICHLORARIA.

*Chlorochroma dichloraria* Gn., Lep. ix. p.365, Pl.vi. f.8; *Chlorochroma vertumnaria* Gn., Lep. ix. p.365; *Geometra submissaria* Wlk., Cat. Brit. Mus. xxii. p.529; *Chlorochroma congenita* Wlk., Cat. Brit. Mus. xxii. p.564; *Iodis dichloraria* Meyr., Proc. Linn. Soc. N. S. Wales 1887, p.884; *Iodis vertumnaria* Meyr., *op cit.* 1887, p.885.

*C. vertumnaria* Gn.=*C. congenita* Wlk., differs only in the wholly crimson cilia. I regard it as merely a variety. *C. dichloraria* varies much in the extent of crimson in the cilia.

Q.: Toowoomba, 1; Warwick, 10—N.S.W.: Newcastle; Sydney, 4, 9—Vic.: Melbourne; Gisborne, 1, 3, 11; Ballarat, Birchip—Tasm.: Launceston; George's Bay; Hobart, 4, 12; Zeehan, 2.

## 33. CHLOROCOMA CARENARIA.

*Chlorochroma carenaria* Gn., Lep. ix. p.366; *Iodis carenaria* Meyr., Proc. Linn. Soc. N. S. Wales 1887, p.881.

♂♀. 28-42 mm. Crown green posteriorly, anteriorly narrowly dull red; fillet whitish-ochreous; face and palpi dull red. Antennæ whitish-ochreous, inner pectinations tinged with reddish; pectinations in ♂ 5. Thorax and abdomen green; a narrow median dorsal whitish-ochreous line from before middle of thorax; apical segments, sides, and lower surface of abdomen whitish. Legs whitish; anterior pair reddish in front. Forewings triangular, costa slightly arched, apex round-pointed, termen nearly straight, oblique; green; costal edge whitish-ochreous, near base reddish; all veins slenderly outlined in whitish; a slightly curved, not dentate, whitish line from mid-dorsum towards, but not reaching costa shortly before apex, becoming attenuated towards extremity; cilia whitish-ochreous, on tornus green. Hindwings with termen bowed, slightly produced at tornus; colour and markings as forewings; but post-median line slightly dentate. Underside green; basal fourth of costa of forewings reddish.

Vic.: Gisborne, 2, 3, 4—Tas.: Hobart.

## 34. CHLOROCOMA ASSIMILIS.

*Iodis assimilis* Luc., Proc. Linn. Soc. N. S. Wales 1888, p.1265; *Iodis commoda* Luc., *op. cit.* 1892, p.252.

♂. 30-34 mm. Crown posteriorly bluish-green, anteriorly crimson; fillet whitish; face deep crimson. Palpi crimson, beneath whitish. Antennæ whitish, stalk and inner pectinations crimson-tinged; pectinations 4-5. Thorax and abdomen bluish-green, with a median dorsal whitish-ochreous streak from mid-thorax; shoulders narrowly crimson; underside whitish. Legs crimson; posterior pair whitish. Forewings triangular, costa nearly straight except near apex, apex pointed, termen nearly straight, oblique; bluish-green; an ochreous costal streak becoming crimson at base; lines usually obsolete; postmedian line sometimes present, straight, from  $\frac{2}{3}$  costa towards apex; cilia whitish-ochreous, at apex crimson. Hindwings with termen bowed; colour and cilia as forewings. Underside pale green.

*I. commoda* Luc., is the form with postmedian line developed.  
Q.: Brisbane, 7—W.A.: Waroona, 5 (Berthoud).

## 35.†CHLOROCOMA MONOCYMA.

*Iodis monocyma* Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.883.  
W.A.: Carnarvon, 10.

## 36.†CHLOROCOMA HALOCHLORA.

*Iodis halochlora* Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.878.  
Perhaps this should be referred to the genus *Euloxia*.  
S.A.: Quorn, 10.

## 37. CHLOROCOMA EXTERNA.

*Chlorochroma externa* Wlk., Cat. Brit. Mus. xxii. p 564; *Iodis externa* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.885.

In my specimens the red line on crown is reduced to a trace. There is a close superficial resemblance between this species and *Prasinocyma semirocea* Wlk., which may be at once distin-

guished by the longer palpi and green face. Probably the relationship is real, as well as apparent.

N.S.W.: Bathurst—Vic.: Gisborne, 3—Tasm.: Deloraine—S.A.: Mt. Lofty.

### 38. CHLOROCOMA PERIPHRACTA.

*Euchloris periphracta* Turn., Trans. Roy. Soc. S. Austr., 1904, p.219.

Q.: Stradbroke Island, 9, 10.

### 39. CHLOROCOMA MELOCROSSA.

*Iodis submissaria* Moyr., Proc. Linn. Soc. N. S. Wales, 1887, p.882, nec Wlk.; *Euchloris xuthocrania* Turn., Trans. Roy. Soc. S. Austr., 1906, p.127; *Chlorochromis citrolimbaria* Wlk., Cat. Brit. Mus. xxii. p.562, nec Gn.; *Iodis melocrossa* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.879.

Mr. Prout has re-examined the type of *I. melocrossa*, and assures me that it is a form of my species, with the lines reduced to white vein-dots.

Q.: Stanthorpe—Vic.: Melbourne; Castlemaine, 3; Monbulk, 11—Tasm.: Deloraine, Strahan—S.A.: Mt. Lofty.

### 40.†CHLOROCOMA ARGOCNEMIS.

*Iodis argocnemis* Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p.883. W.A.: Perth.

### 41. CHLOROCOMA TETRASPILA.

*Euchloris tetraspila* Low., Trans. Roy. Soc. S. Austr. 1901, p.66.

♂. 25-28 mm. Head green; fillet white; face green. Palpi green; terminal joint crimson. Antennæ white, inner pectinations slightly crimson-tinged; pectinations 6. Thorax and abdomen green; beneath whitish. Legs pale crimson, posterior pair whitish. Forewings triangular, costa moderately arched, apex pointed, termen nearly straight, oblique; green; costal edge pale crimson; a fuscous discal dot margined with ferruginous; lines nearly obsolete, indicated by minute whitish specks on veins;

cilia green, apices whitish. Hindwings with termen angled and slightly produced on vein 4; colour, lines, and cilia as forewings; discal dots as forewings, but slightly larger; cilia on angle sometimes tinged with ferruginous. Type in Coll. Lyell.

The shape of the hindwings is peculiar in the genus.

Vic.: Gembrook, near Beaconsfield—Tasm.: Kelso, 3.

#### 42. CHLOROCOMA ASHMANA.

*Iodis asemanta* Meyr., Proc. Linn. Soc. N.S. Wales, 1887, p. 879.

A specimen sent by Mr. G. A. Berthoud, which I refer to this species, differs slightly from Mr. Meyrick's description, as follows:—♂. Face green, its upper edge and a few scattered scales crimson; fillet pale pink. Palpi very short( $\frac{1}{2}$ ); pinkish. Fore and middle legs suffused with pink.

W.A.: Carnarvon; Waterloo, 5.

#### 43. CHLOROCOMA STEREOTA.

*Iodis stereota* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 875.

Vic.: Melbourne, 10; Gisborne, 3, 4, 11, 12.

#### 44. CHLOROCOMA NEPTUNUS.

*Chlorochroma neptunus* Butl., Trans. Ent. Soc. 1886, p. 435;

*Iodis neptunus* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 881.

Antennal pectinations of ♂ 6.

Q.: Rockhampton; Rosewood, 4.

#### 45. CHLOROCOMA TACHYFORA, n.sp. [*ταχύροπος*, quick of motion.]

♂. 20-24 mm. Head bluish-green, fillet broadly snow-white, face yellowish-green. Palpi extremely short, scarcely exceeding  $\frac{1}{2}$ ; whitish. Antennæ white; pectinations in ♂, anterior 4, posterior 6. Thorax and abdomen bluish-green; tuft, sides, and lower surface white. Legs whitish; anterior pair grey-whitish. Forewings triangular, costa nearly straight, apex round-pointed, termen nearly straight, oblique; a broad white costal streak narrowing at base and apex; lines whitish, dentate, indistinct; first at  $\frac{1}{3}$ , second at  $\frac{2}{3}$ , approaching first towards dorsum; an

obscure darker green median discal dot; cilia whitish-green. Hindwings with termen rather strongly bowed; colour, lines, discal dot, and cilia as forewings. Underside green-whitish.

This little species is nearest *C. neptunus*. The frenulum is very slender. Although the palpi are unusually small, the tongue is well developed. Type in Coll. Turner.

Q.: Stradbroke Island; in February and August; two specimens.

#### Gen. 12. MAXATES.

*Maxates* Moore, Lep. Ceyl. iii. p. 436; Hmps., Moths Ind. iii. p. 505.

Face smooth. Tongue well-developed. Palpi  $1\frac{1}{2}$ ; second joint long, thickened with rough scales beneath; terminal joint stout, obtuse in ♂,  $\frac{1}{4}$ . Antennæ of ♂ pectinated, apices simple; of ♀ simple. Thorax and abdomen not crested; thorax only slightly hairy beneath. Posterior tibiæ with all spurs present; in ♂ dilated, terminal spurs shortened, and a tuft of long hairs in a groove on inner side. Hindwings with a strong rounded costal expansion; frenulum in ♂ present but weak, retinaculum near base of forewing. Forewings with 3 and 4 connate or stalked; 11 anastomosing with 12. Hindwings quadrate, acutely angled and strongly produced on vein 4; 3 and 4 stalked, 6 and 7 stalked, 8 closely approximated to cell for a short distance, diverging before middle; discocellulars somewhat angled on vein 5, posterior curved and becoming strongly oblique towards dorsal angle of cell; costal edge of cell considerably over  $\frac{3}{4}$ . Type *M. calataria* Wlk., from India.

A small genus differing from *Prasinocyma* in the shape of the hindwings.

#### 46. MAXATES TANYGONA.

*Euchloris tanygona* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 220.

Q.: Mount Tambourine, 11.

#### Gen. 13. ERETMOPOUS, n.g. [*ipetmonous*, paddle-footed.]

Face smooth. Tongue well-developed. Palpi over 1; second joint thickened with roughish hairs; terminal joint well de-

veloped. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax moderately hairy beneath. Posterior legs of ♂ sub-aborted, tibiæ and tarsi dilated and clothed with rough hair, all spurs absent, tarsi flattened and closely appressed beneath abdomen. Hindwings with a slight costal expansion at base; frenulum in ♂ present but weak; retinaculum close to base of forewing. Forewings with 3 and 4 slightly separate at origin, 6 stalked, 11 from cell, not anastomosing. Hindwings with 3 and 4 connate or stalked\*, 5 strongly approximated to 6, 6 and 7 stalked, 8 closely approximated to cell for some distance, diverging shortly before middle; discocellulars not angled and only slightly oblique.

A development of *Prasinocyna*. The hindlegs of the ♂ have an extraordinary resemblance to those of *Eois eretmopus*, Turn., but have been independently developed, there being no near kinship between the two. Type *Thalassodes marinaria*, Gn.

#### 47. ERETMOPIUS MARINARIA.

*Thalassodes marinaria* Gn., Lep. ix. p.361; Hmps., Moths Ind. iii. p.508; *Geometra discissa* Wlk., Cat. Brit. Mus. xxii. p.517; *Geometra penicillata* Wlk., Cat. Brit. Mus. xxii. p.525.

♂. 38 mm. Crown green, with a very narrow faint reddish line anteriorly; fillet broadly snow-white; face and palpi grey-brown. Antennæ white, towards apices ochreous-tinged; pectinations in ♂ 3. Thorax and abdomen bluish-green; tuft, sides and under surface whitish. Legs whitish; anterior pair dull purple-brown. Forewings triangular, costa nearly straight to near apex, then strongly arched, apex rounded, termen slightly bowed, oblique; bluish-green with faintly paler transverse strigulae sparsely distributed; costal edge whitish-ochreous, at base whitish; cilia whitish, with minute fuscous dots at end of veins. Hindwings obtusely bowed on vein 4; as forewings. Underside green-whitish; costa of forewings and base of hindwings tinged with ochreous.

\* Stalked in my exampled, not stalked according to Sir Geo. Hampson.

This seems to agree sufficiently with descriptions drawn from Indian examples, which are, however, rather larger. On a casual inspection it might be confused with *C. albicosta* Wlk.

N.A.: Port Darwin; in December; one specimen, received from Mr. F. P. Dodd. Also from Borneo and India.

#### Gen. 14. COMIBÆNA.

*Comibæna* Hb., Verz. p.284; *Comostolodes* Warr., Nov. Zool. 1896, p.308; *Probolosceles* Warr., Nov. Zool. 1896, p.368.

Face smooth. Tongue well-developed. Palpi moderate or rather long; second joint roughly scaled; terminal joint in ♂ short, in ♀ moderately elongate. Antennæ in ♂ pectinated, apices simple, in ♀ simple. Thorax not crested; slightly hairy beneath. Abdomen sometimes with faint indications of dorsal crests. Posterior tibiae with all spurs present; in ♂ with a long slender terminal process about half as long as tarsus. Hindwings with a strong rounded costal expansion at base; frenulum in ♂ present but very slender, retinaculum close to base of forewing; frenulum in ♀ represented by a few weak hairs. Forewings with 3 and 4 connate or stalked, 6 separate or stalked, 11 from cell or stalked with 7, 8, 9, 10 beyond 6, free or running into 12. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 closely approximated to cell near base, diverging before middle; discocellulars not angled on vein 5, only moderately oblique.

Although, as will be noted below, there are substantial differences between the neuration of the forewings of the two Australian species, yet, in view of the variability of the same points in the genus *Comostola*, I do not think they can be relied on for generic separation. The genus is best characterised by the posterior tibial process, which is an exaggeration of a structure found to a slighter extent in some other genera; but in the latter (except in *Eucyclodes callistiota*) never attaining half the length of the tarsus. Type *C. pustulata* Hufn., from Europe.

48. *COMIBÆNA INDUCTARIA*.

*Phorodesma inductaria* Gn., Lep. ix. p.370: *Nemoria smaragdus* Hmps., Ill. Het. viii. p.110, Pl.151, f.15; Moths Ind. iii. p.504: *Comostolodes consobrina* Warr., Nov. Zool. 1897, p.210.

♂. 14-16 mm., ♀. 21 mm. Crown and fillet green; face green, narrowly margined above, below, and on sides with white, which sometimes contains a few reddish scales. Palpi whitish, partly greenish-tinged; terminal joint in ♂  $\frac{1}{8}$ , in ♀  $\frac{1}{3}$ . Antennæ white; pectinations in ♂ 5. Thorax green; crossed anteriorly by a narrow white line, margined posteriorly with pale red. Abdomen green; a white dorsal spot at base, and a second and larger white spot about middle, both edged with pale red; apex, sides, and undersurface whitish. Legs whitish; anterior femora and tibiae annulated in ♂ with green, in ♀ with fuscous. Forewings with costa moderately arched, apex rounded, termen bowed, oblique; 3 and 4 short-stalked; 11 stalked with 7, 8, 9, 10, usually running into 12, sometimes free; bright green; a white costal streak, narrowly edged with pale red, and expanded into spots at  $\frac{1}{3}$  and  $\frac{2}{3}$ ; several white spots edged with pale red; one on dorsum at  $\frac{2}{3}$ , and another on median vein at  $\frac{1}{3}$ , together with first costal spot represent antemedian line; one on tornus, and one on vein 4 at  $\frac{2}{3}$ , together with second costal spot and some intermediate dots represent postmedian line; a terminal series of similar dots on veins; cilia whitish-ochreous with a reddish fuscous basal line. Hindwings with termen strongly bowed; as forewings, but without discal, costal, and dorsal spots, and with large spots on tornus and termination of vein 4. Underside whitish-green.

N.Q.: Cooktown; Kuranda, 3, 4, 9, 10; Townsville, 12.

49. *COMIBÆNA MARIÆ*.

*Iodis mariæ* Luc., Proc. Linn. Soc. N. S. Wales, 1888, p.1266; *Probolesceles albipunctata* Warr., Nov. Zool., 1898, p.15; *Probolesceles connata* Warr., Nov. Zool. 1898, p.15.

♂♀. 22-32 mm. Crown and fillet green; face green, narrowly margined above, below, and at sides with white. Palpi purple-



fuscous, base white beneath; in ♂ 1½, terminal joint ½; in ♀ 2½, terminal joint ¾. Antennæ white, base of stalk green. Thorax green. Abdomen grey-brown; with a lateral greenish suffusion before middle, and three triangular snow-white median dorsal spots; apex, sides, and undersurface white. Legs white; anterior and middle pairs annulated with fuscous; anterior tibiae with a dense posterior tuft of fuscous hairs in both sexes. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; 3 and 4 connate, 11 from cell, free; bright green; a slender white costal streak; a minute grey-brown discal dot; a large grey-brown tornal blotch, sometimes pale-centered, somewhat variable in form, with wavy margin; a slender grey-brown terminal line, interrupted by white dots on veins; cilia whitish-ochreous, with a broad interrupted grey-brown basal line. Hindwings with termen rounded; as forewings, but with a large apical instead of a tornal blotch.

The green fillet, white-margined face, and white dots on abdomen are interesting indications of affinity to *C. inductaria*.

Mr. R. Illidge informs me that the larvae feed on the flowers of *Acacia*, and are concealed by withered fragments of the flowers adhering to them.

N.Q.: Herberton; Kuranda, 3—Q.: Duaringa; Brisbane, 3, 4.

#### Gen. 15. *CENOSPILA*.

*Cenospila* Swin., Trans. Ent. Soc. 1892, p. 5; Hmps., Moths Ind. iii. p. 508.

Face smooth. Tongue well developed. Palpi in ♀ very long, second joint long, terminal joint ¾. Antennæ of ♂ pectinated, apices simple; of ♀ simple. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiae of ♂ with terminal spurs absent; of ♀ with terminal spurs shortened, especially outer; inner proximal spur long, outer short in both sexes. Hindwings with a strong costal expansion at base; frenulum in ♀ obsolete. Forewings with 3 and 4 separate, 6 stalked, 11 from cell, not

anastomosing. Hindwings with 3 and 4 long-stalked, 5 closely approximated to 6 at origin, 8 touching cell near base, rapidly diverging; discocellulars only slightly oblique. Type, *O. flavifusata* Wlk.

I have been able to examine only the ♀; for the characters of the ♂ I rely on Sir Geo. Hampson (*loc. cit.*). The posterior tibiae distinguish it from *Prasinocyma*, of which it is an immediate derivative.

#### 50. *CENOSPILA FLAVIFUSATA*.

*Thalera flavifusata* Wlk., Cat. Brit. Mus. xxii. p.596; *Thalassodes sinuata* Moore, Proc. Zool. Soc. 1867, p.437; *Thalassodes flavifusata* Hmps., Moths Ind. iii. p.508; *Cenospila flavilinea* Warr., Nov. Zool. 1897, p.212; *Gelasma*(?) *perlinnata* Warr., Nov. Zool. 1899, p.330.

♀. 26-28 mm. Head and face green; fillet snow-white. Palpi whitish-green. Antennæ white, towards apex grey-brown. Thorax and abdomen green; sides and undersurface whitish. Legs whitish; anterior tibiae and tarsi grey-brown. Forewings elongate-triangular, costa slightly arched, apex pointed, termen slightly bowed, oblique; bright green; slightly darker, sharply dentate, antemedian and postmedian lines discernible with difficulty; reddish-fuscous dots on dorsum at  $\frac{1}{3}$  and  $\frac{2}{3}$ , at extremities of lines; a similar discal dot; a snow-white costal streak not extending to base, margined by a slender yellow streak, which becomes reddish towards apex; a narrow dark red terminal line, interrupted by white dots on ends of veins; cilia reddish, apices paler. Hindwings with termen bowed and slightly dentate, tooth on vein 4 being the most developed; colour and markings as forewings, but costal streaks and antemedian line obsolete. Under-side green-whitish.

N.Q.: Cooktown, Cairns, Geraldton; Kuranda, 6. Also from Solomons, Java, Borneo, Ceylon, and India.

#### Gen. 16. *THALASSODES*.

*Thalassodes* Gn., Lep. ix. p.359; Hmps., Moths Ind. iii. p.507.

Face smooth, with a slight projecting tuft of scales at lower

edge. Tongue well developed. Palpi rather long, ascending; second joint rough-haired beneath; terminal joint stout, obtuse, well developed in both sexes. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax moderately or densely hairy beneath. Posterior tibiae with all spurs present; in ♂ sometimes strongly dilated, with a short stout terminal process. Hindwings strongly angled on vein 4; with a moderately strong costal expansion at base; frenulum in ♂ rather slender, retinaculum near base of forewing; frenulum in ♀ obsolete. Forewings with 3 and 4 usually short-stalked, rarely connate, 6 stalked, 11 free. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 closely approximated to cell as far as middle, then diverging; discocellulars nearly straight, slightly wavy, strongly oblique, costal edge of cell  $\frac{3}{4}$ . Type, *Thalassodes quadraria* Gn.

As restricted, this is a small genus, which I regard as a development of *Prasinocyma* having most affinity to *P. ocyptera* and *P. albicosta*. Its most striking characteristic is the extremely oblique margin of the cell of hindwing, with its appreviated costal edge. The three species are extremely similar.

- |  |                         |
|--|-------------------------|
| 1. Face purple-brown.....              | 51. <i>quadraria</i> .  |
| Face green.....                        | 2.                      |
| 2. Posterior tibiae of ♂ dilated.....  | 52. <i>vararia</i> .    |
| Posterior tibiae of ♂ not dilated..... | 53. <i>dorsilinea</i> . |

#### 51. THALASSODES QUADRARIA.

*Thalassodes quadraria* Gn., Lep. ix. p.360; Hmps., Moths Ind. iii. p.507; *Geometra digressa* Wlk., Cat. Brit. Mus. xxii. p.513; *Geometra dissita* Wlk., Cat. Brit. Mus. xxii. p.519; *Geometra semihyalina* Wlk., Cat. Brit. Mus. xxii. p.528; *Thalassodes dissepta* Wlk., Cat. Brit. Mus. xxii. p.550; *Thalassodes immisarius* Wlk., Cat. Brit. Mus. xxii. p.553; *Thalassodes depulsata* Wlk., Cat. Brit. Mus. xxii. p.555; *Thalassodes inconclusaria* Wlk., Cat. Brit. Mus. xxii. p.556; *Thalassodes byrsopsis* Meyr., Proc. Linn. Soc. N. S. Wales, 1886, p.249; *Iodis byrsopsis* Meyr., op. cit., 1887, p.902; *Iodis implicata* Luc., op. cit., 1891, p.293.

Palpi in ♂  $1\frac{1}{2}$ ; terminal joint  $\frac{1}{2}$ . Posterior tibiae of ♂ dilated, with a groove containing a tuft of hairs on inner side, terminal

spurs not notably abbreviated, and a short stout terminal process.

I doubt whether *Thalassodes pilaria* Gn., from Tahiti, is really identical.

N.A.: Port Darwin, 12—N.Q.: Kuranda, 4; Atherton—Q.: Rockhampton. Also from New Guinea, Celebes, Borneo, Ceylon, and India.

## 52. THALASSODES VERARIA.

*Thalassodes veraria* Gn., Lep. ix. p.360; Hmps., Moths Ind. iii. p.508: *Thalassodes opalina* Butl., Ann. Mag. Nat. Hist.(5). vi. 1882, p.214; *Iodis rhytiphorus* Low., Trans. Roy. Soc. S. Austr., 1893, p.156.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Differs from *T. quadraria* in the green face and green upper surface of palpi. Otherwise they seem almost indistinguishable. My examples are also slightly larger; the postmedian line of forewings is also more distinct, straighter, less wavy, the terminal process of posterior tibiae of ♂ is rather longer, and there is a fine interrupted median dorsal line on abdomen, but I cannot be sure that these differences are constant.

N.Q.: Thursday Island, Cooktown; Kuranda, 5. Also from Java, Ceylon, and India.

## 53. THALASSODES DORSILINEA.

*Thalassodes dorsilinea* Warr., Nov. Zool. 1903, p.364.

♂. 28-30 mm.; ♀. 32-37 mm. Crown bluish-green; fillet broadly white; face green. Palpi of ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; of ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; green, beneath whitish. Antennæ ochreous-whitish, sometimes greenish-tinged, towards base white; pectinations in ♂ 6. Thorax and abdomen bluish-green, with a fine uninterrupted median whitish line from centre of thorax; sides and under surface whitish; thorax only moderately hairy beneath. Legs whitish; anterior and middle tibiae and tarsi pale brownish-ochreous; posterior tibiae of ♂ not dilated, without groove and tuft of hairs, and without terminal process.

Forewings triangular, costa nearly straight, arched before apex, apex round-pointed, termen nearly straight, oblique; bluish-green with small white transverse strigulations; lines whitish, converging; antemedian near base, from beneath  $\frac{1}{8}$  costa to  $\frac{1}{4}$  dorsum, often indistinct; postmedian from beneath  $\frac{2}{3}$  costa to  $\frac{2}{3}$  dorsum, straight; a whitish-ochreous streak along costa from near base; cilia whitish. Hindwings with termen angled on vein 4, straight on each side of angle; colour and markings as forewings, but lines obtusely bent in disc and thence crenate to dorsum. Underside whitish-green.

Mr. L. Prout has kindly examined, for me, the type of this species, which is very like *T. veraria* but considerably smaller, shorter palpi; and is immediately distinguished by the ♂ posterior tibiae.

N.A.: Port Darwin, 12—N.Q.: Kuranda, 1, 2, 3; Geraldton, 5. Also from New Guinea.

#### Gen. 17. PRASINOCYMA.

*Prasinocyma* Warr., Nov. Zool. 1897, p. 44.

Face smooth. Tongue well developed. Palpi moderate or rather long; terminal joint in ♂ short or moderate, in ♀ always elongate. Antennae in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax slightly or moderately hairy beneath. Posterior tibiae with all spurs present; in ♂ sometimes dilated, with a tuft of long hairs in groove on inner side, and terminal spurs abbreviated; rarely with a short terminal process. Hindwings with a strong costal expansion at base; frenulum in ♂ present but slender, retinaculum close to base of forewing; in ♀ obsolete. Forewings with 3 and 4 separate, connate, or short-stalked, 6 separate or stalked, 11 free or anastomosing with 12, rarely also with 10. Hindwings with 3 and 4 usually stalked; sometimes connate, 6 and 7 stalked, 8 closely approximated to cell for some distance, diverging before middle; discocellulars slightly or not at all angled on vein 5, dorsal straight or curved, moderately or rather strongly oblique, costal edge of cell considerably exceeding  $\frac{1}{2}$  dorsal edge. Type,

*Thalassodes vermicularis* Gn., an African species closely allied to *P. albicosta* Wlk.

The species included by me in this genus, show considerable variety of facies, and considerable variation also in certain details of structure, as will be noted below, and may possibly need to be divided.

- |   |                           |
|---|---------------------------|
| 1. Face crimson.....  | 54. <i>rhodocosma</i> .   |
| Face ferruginous or brown.....                                | 2.                        |
| Face green.....   | 4.                        |
| 2. Wings with dark reddish-brown lines.....                   | 55. <i>texotérica</i> .   |
| Wings without dark reddish-brown lines .....                  | 3.                        |
| 3. Hindwings with termen angled and projecting on vein 4..... | 56. <i>teronhola</i> .    |
| Hindwings with termen rounded.....                            | 57. <i>cryptera</i> .     |
| 4. Hindwings with termen rounded.....                         | 5.                        |
| Hindwings with termen angled on vein 4.....                   | 6.                        |
| 5. Wings with numerous transverse whitish strigulae.....      | 58. <i>albicosta</i> .    |
| Wings not strigulated.....                                    | 59. <i>semicrocea</i> .   |
| 6. Forewings with a snow-white costal streak .....            | 7.                        |
| Forewings without a snow-white costal streak.....             | 8.                        |
| 7. Cilia green barred with white and reddish.....             | 60. <i>iostricta</i> .    |
| Cilia whitish.....  | 63. <i>floresaria</i> .   |
| 8. Discal dots obscure green.....                             | 9.                        |
| Discal dots ferruginous-fuscous.....                          | 10.                       |
| 9. Wings with slender dark green lines.....                   | 61. <i>centrophylla</i> . |
| Wings with lines represented by white dots on veins..         | 62. <i>calaina</i> .      |
| 10. Discal dots large, no terminal blotches.....              | 64. <i>phaeostigma</i> .  |
| Discal dots minute, large grey-brown terminal blotches        | 65. <i>anomaea</i> .      |

#### 54. PRASINOCYMA RHODOCOSMA.

*Iodis rhodocosma* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 889.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Posterior tibiae of ♂ moderately dilated, with a tuft of hairs from base on inner side, terminal spurs rather short. Forewings with 3 and 4 connate, rarely short-stalked, 6 connate or short-stalked, 11 free, or rarely anastomosing shortly with 12. Hindwings with 3 and 4 stalked; discocellulars very slightly angled, dorsal moderately oblique.

N.Q.: Atherton; Townsville, 3, 4—Q.: Brisbane, 2, 3, 4, 7,  
12—N.S.W.: Newcastle, Sydney—W.A.: Waroona, 12.

#### 55. †PRASINOCYMA EXOTERICA.

*Iodis exoterica* Meyr., Proc. Linn. Soc. N. S. Wales, 1887,  
p.891.

N.S.W.: Newcastle.

#### 56. †PRASINOCYMA CROSSOTA.

*Iodis crossota* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.894.  
Q.: Brisbane.

#### 57. PRASINOCYMA OCYPTERA.

*Iodis ocyptera* Meyr., Proc. Linn. Soc. N. S. Wales, 1887,  
p.887; *Iodis gracilis* Luc., Proc. Linn. Soc. N. S. Wales, 1888,  
p.1266.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀ 2, terminal joint  $\frac{3}{4}$ .  
Posterior tibiae in ♂ not thickened. Forewings with 3 and 4  
connate, 6 usually stalked, sometimes connate, 11 free. Hind-  
wings with 3 and 4 stalked; discocellulars straight and rather  
strongly oblique.

Q.: Brisbane, 2, 4, 8—W.A.: Carnarvon, Geraldton, 10, 11.

The localities for this species are at extreme ends of the  
continent. Doubtless subsequent discoveries will fill up the gap.

#### 58. PRASINOCYMA ALBICOSTA.

*Geometra albicosta* Wlk., Cat. Brit. Mus. xxii. p.529; *Iodis*  
*albicosta* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.888;  
*Iodis bicolora* Luc., Proc. Linn. Soc. N. S. Wales, 1888, p.1265;  
*Thalassodes flavicosta* Warr., Nov. Zool. 1897, p.214.

Antennal pectinations in ♂ 6. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  
 $\frac{1}{2}$ ; in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{3}{4}$ . Posterior tibiae in ♂ not dilated.  
Forewings with 3 and 4 separate, connate, or stalked, 6 separate  
or stalked, 11 free. Hindwings with 3 and 4 stalked; dis-  
cocellulars nearly straight, rather strongly oblique.

Mr. Prout has kindly examined for me the type of *T. flavicosta* Warr.

N.A.: Port Darwin—N.Q.: Cape York, 11—Q.: Brisbane, 5.

#### 59. PRASINOCYMA SEMICROCEA.

*Geometra semicrocea* Wlk., Cat. Brit. Mus. xxii. p.528;  
*Chlorochroma intermixta* Wlk., Cat. Brit. Mus. xxii. p.563;  
*Chlorochroma decisissima* Wlk., Cat. Brit. Mus. xxii. p.564;  
*Iodis semicrocea* Meyr., Proc. Linn. Soc. N. S. Wales, 1887,  
 p.887; *Iodis subalpina* Luc., Proc. Linn. Soc. N. S. Wales, 1888,  
 p.1264.

Pectinations of antennæ and terminal part of stalk in ♂ sometimes suffused with crimson. Palpi sometimes green, sometimes crimson, beneath whitish; in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀ 2, terminal joint  $\frac{3}{4}$ .

Q.: Brisbane—N.S.W.: Glen Innes, Sydney—Vic.: Gisborne, 3, 4, 11; Fernshaw, Moe, Bairnsdale—Tasm.: Hobart—S.A.: Mt. Lofty.

#### 60. PRASINOCYMA IOSTICTA.

*Iodis iosticta* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.893.

Posterior tibiæ in ♂ greatly dilated, and terminal spurs much abbreviated.

Q.: Brisbane, 8; Southport—N.S.W.: Newcastle.

#### 61. PRASINOCYMA CENTROPHYLLA.

*Iodis centrophylla* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.880; *Iodis angulata* Luc., Proc. Linn. Soc. N. S. Wales, 1888, p.1264.

Palpi in both sexes  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Posterior tibiæ in ♂ not dilated. Frenulum in ♂ very slender, easily overlooked. Forewings with 3 and 4 short-stalked or connate, 6 separate, 11 anastomosing with 12. Hindwings with 3 and 4 short-stalked or connate; discocellulars angled on vein 5, moderately oblique.

Vein 11 is closely applied to 10 also in my examples, but not anastomosing. I have no doubt that Mr. Meyrick is right in stating that it sometimes anastomoses.



Q.: Brisbane, Stradbroke Island, Toowoomba, 11—N.S.W.: Sydney—Vic.: Melbourne; Beaconsfield, 3, 11; Gisborne, 11—Tas.: George's Bay; Kelso, 3; Georgetown, 4.

62. *PRASINOCYMA CALAINA*, n.sp. [*καλαίνος*, bluish-green.]

♂♀. 30-33 mm. Head, face, and palpi green; fillet white. Antennæ white; pectinations in ♂ 6, inner row green-tinged. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{3}$ ; in ♀ 2, terminal joint  $\frac{2}{3}$ . Thorax and abdomen bluish-green; tuft, sides, and under surface white. Legs white; anterior pair, except coxæ, green. Forewings triangular, costa gently arched, more strongly at base, apex acute, termen nearly straight, oblique; 3 and 4 separate, 6 separate, 11 free; bluish-green; costal edge narrowly whitish-ochreous; antemedian line represented by three or four whitish dots on veins; discal dot linear, obscure, dark green; postmedian line represented by a straight series of white dots on veins at  $\frac{2}{3}$ ; cilia bluish-green, apices whitish. Hindwings with termen angled on vein 4; 3 and 4 connate, discocellulars not angled, dorsal slightly oblique; as forewings, but antemedian line obsolete, and postmedian line angled. Under side whitish-green, darker towards costa of forewings. Type in Coll. Turner.

Q.: Mount Tambourine; in September and in April; two specimens.

63. *PRASINOCYMA FLORESARIA*.

*Geometra floresaria* Wlk., Cat. Brit. Mus. xxxv., p.1604; *Iodis oxycentra* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.888.

Antennal pectinations in ♂ 4. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{3}$ ; in ♀ 2, terminal joint  $\frac{2}{3}$ . Posterior tibiae of ♂ dilated, with terminal spurs abbreviated, and a stout terminal process. Forewings with 3 and 4 separate, 6 separate, 11 free or anastomosing with 12. Hindwings with 3 and 4 connate or short-stalked; discocellulars nearly straight, slightly oblique.

N.Q.: Cairns; Kuranda, 3, 4, 6, 9, 10; Townsville, 12. Also from Flores.

64. PRASINOCYMA PHAEOSTIGMA, n.sp.[*φαιοστιγμος*, darkly branded.]

♀. 40 mm. Head bluish-green; fillet white; face bluish-green, lower edge white. Palpi in ♀ moderately long ( $1\frac{1}{2}$ ), terminal joint  $\frac{3}{4}$ , acute; bluish-green, beneath whitish. Antennæ white, towards apex pale brownish. Thorax and abdomen bluish-green; sides and under surface whitish. Legs whitish; anterior pair pale brownish. Forewings triangular, costa strongly arched at base, thence nearly straight, slightly sinuate, apex round-pointed, termen moderately bowed, oblique; 3 and 4 separate, 6 short-stalked, 11 free or anastomosing (approximated to 12 at a point, probably sometimes anastomosing, anastomosing shortly with 10 on one side only); bluish-green, rather thinly scaled; costal edge narrowly whitish-ochreous; lines obsolete; a fuscous discal spot on posterior edge of cell, surrounded by a brownish halo, and preceded by a crescentic fuscous mark; cilia concolorous. Hindwings with termen rounded, crenulate, dentate on vein 4; 3 and 4 short-stalked, 8 approximated to cell near middle, then diverging, discocellulars angled on vein 5, moderately oblique; as forewings, but discal spot preceded by a roundish spot. Under-side whitish, thinly scaled. Type in Coll. Turner.

N.Q.: Kuranda; in November; one specimen received from Mr. F. P. Dodd.

65. PRASINOCYMA ANOMOEIA, n.sp.[*ἀνόμοιος*, unlike, dissimilar.]

♀. 36 mm. Head green; fillet broadly purple-brown; face green, lower edge purple-brown. Palpi in ♀ 2, terminal joint  $\frac{3}{4}$ , obtuse; purple-brown, undersurface whitish. Antennæ purple-brown. Thorax green, with a large posterior purple-white spot, edged and irrorated with dark fuscous. Abdomen purple-white, with slight dark fuscous irroration; undersurface ochreous-whitish. Legs ochreous-whitish; anterior pair, middle tibiae, and tarsi brownish. Forewings triangular, costa nearly straight to near apex, then strongly arched, apex rounded, termen bowed, oblique, wavy; 3 and 4 connate, 6 connate, 11 free; bright green; costal edge brownish;

a ferruginous erect streak from  $\frac{1}{2}$  dorsum to mid-disc; a minute discal dot, dark fuscous with some ferruginous scales; a very large tornal and terminal blotch with lobed outline, from  $\frac{2}{3}$  dorsum to near costa, then narrowing and ending just below apex, purple-whitish, suffused partly with ferruginous, strigulated with fuscous, and edged with ferruginous-fuscous; a dark fuscous terminal line; cilia ochreous-whitish, with a faint purplish median line. Hindwings with termen dentate on veins 4 and 6; 3 and 4 short-stalked, 8 approximated to cell for a short distance near base; discocellulars nearly straight, oblique; as forewings, but with a large apical and smaller tornal blotch connected with a straight-edged bridge; the latter prolonged along dorsum nearly to base as a narrow streak. Underside whitish-green; a large dark fuscous blotch on forewings from tornus nearly to costa; a smaller subapical blotch on hindwings. Type in Coll. Lyell.

N.Q.: Kuranda; in April; one specimen, received from Mr. F. P. Dodd.

#### Gen. 18. DIPLODESMA.

*Diplodesma* Warr., Nov. Zool. 1896, p. 289.

Face smooth. Tongue well developed. Palpi moderate in ♂, rather long in ♀; second joint rough-scaled beneath; terminal joint in ♂ abbreviated. Antennæ in ♂ ciliated, in ♀ simple. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiae in ♂ dilated, middle spurs absent; in ♀ with all spurs present. Hindwings with a strong costal expansion at base; frenulum in ♂ present but slender, retinaculum near base of forewing; frenulum in ♀ obsolete. Forewings with 3 and 4 short-stalked or connate, 6, 7, 8, 9, 10, 11 stalked, 10 and 11 short and running into 12. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 touching cell at a point near base, then rapidly diverging; discocellulars nearly straight, moderately oblique.

A derivative of *Hemithys*, from which it differs in veins 10 and 11 of forewing arising out of 9 and running into 12, a character which I have not found elsewhere in this group. Type, *Thalera celataria* Wlk.

## 66. DIPILODREMA OBLATARIA.

*Thalera celataria* Wlk., Cat. Brit. Mus. xxxv. p. 1614; *Idiochlorea contracta* Warr., Nov. Zool. 1896, p. 107; *Euchloris thalassica* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 221.

Antennal ciliations in ♂ 1. Palpi in ♂ 1½, terminal joint very short; in ♀ 2, terminal joint ¾. In two ♀ examples from Port Darwin the discal dots are obsolete.

N.A.: Port Darwin, 2, 10—N.Q.: Kuranda, 3, 4, 10, 12. Also from Sula Islands and India.

## Gen. 19. HEMITHEA.

*Hemithea* Dup., Lep. France, iv. 2, p. 233; Hmps., Moths Ind. iii. p. 490.

Face smooth. Tongue well developed. Palpi in ♂ moderate, terminal joint short; in ♀ long, terminal joint long. Antennae in ♂ more or less serrate, ciliated, in ♀ simple. Thorax not crested, slightly hairy beneath. Abdomen with a series of minute dorsal crests. Posterior tibiae in ♂ dilated, with a short terminal process, middle spurs absent; in ♀ with all spurs present. Hindwings with a strong rounded costal expansion at base; frenulum in ♂ present but slender, retinaculum close to base of forewing; frenulum in ♀ obsolete. Forewings with 3 and 4 connate or short-stalked, 11 free or rarely anastomosing with 12. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 approximated to cell near base, rapidly diverging; discocellulars nearly straight, moderately oblique. Type, *H. strigata* Müll., from Europe.

With the preceding and two following genera it forms a closely connected natural group, whose affinities are not very clear. *Nemoria* Hb., which is closely allied, differs in the absence of abdominal crests.

1. Ollis whitish.....	69. <i>pisina</i> .
Ollis greenish or grey.....	2.
2. Wings with white lines.....	67. <i>insularia</i> .
Wings with green lines and white dots.....	65. <i>pellucidula</i> .

## 67. HEMITHEA INSULARIA.

*Hemithea insularia* Gn., Lep. ix. p.385; *Iodis wuka* Pag., J.B. NATH. Vol. xxxix. p.153(1886); *Nemoria iosoma* Meyr., Trans. Ent. Soc. 1889, p.495; *Hemithea pictifimbria* Warr., Nov. Zool. 1896, p.290.

Antennal ciliations in ♂  $\frac{2}{3}$ . Palpi in ♂  $1\frac{1}{4}$ , terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{2}$ , terminal joint  $\frac{2}{3}$ .

N.Q.: Kuranda, 9, 11; Townsville, 1, 2, 3, 5, 6, 7, 12. Also from New Guinea and Borneo.

## 68. HEMITHEA PELLUCIDULA.

*Nemoria pellucidula* Turn., Trans. Roy. Soc. S. Austr. 1896, p.129.

Antennal ciliations in ♂ 1. Palpi in ♂  $1\frac{1}{4}$ , terminal joint  $\frac{1}{2}$ ; in ♀ 2, terminal joint  $\frac{2}{3}$ .

N.Q.: Kuranda, 5, 9, 10.

## 69. HEMITHEA PISINA.

*Nemoria pisina* Warr., Nov. Zool. 1899, p.26.

Palpi in ♀ 2, terminal joint  $\frac{1}{2}$ .

I identified this species by comparison with the type. Unfortunately the Australian example is a female in poor condition, with the legs broken off. Structurally it agrees with the definition of the genus, so far as can be ascertained.

N.A.: Port Darwin, 3 (Coll. Lyell). Also from Tenimber Islands.

## Gen.20. METALLOCHLORA.

*Metallochloa* Warr., Nov. Zool. 1896, p.290.

Face smooth. Tongue well developed. Palpi in ♂ moderate or rather short, in ♀ moderate or rather long; basal joint hairy, second joint smooth-scaled; terminal joint in ♂ abbreviated. Antennae in ♂ ciliated, in ♀ simple. Thorax not crested, slightly or moderately hairy beneath. Abdomen usually with three to five rounded metallic median dorsal crests. Posterior tibiae in ♂ dilated, with a short terminal process; all spurs present. Hind-

wings angulated, and sometimes strongly produced on vein 4; a strong costal expansion at base; frenulum in ♂ present but slender, in ♀ obsolete. Forewings with 3 and 4 connate or short-stalked, 6 connate or short-stalked, 11 free. Hindwings with 3 and 4 long-stalked, 6 and 7 stalked, 8 touching cell at a point near base, then rapidly diverging; discocellulars not angled on vein 5, moderately oblique, dorsal sometimes curved so as to become strongly oblique.

Differs from *Hemithea* in the presence of middle spurs in ♂. Type, *M. meeki* Warr., from the Louisiades.

- |   |                         |
|---|-------------------------|
| 1. Hindwings dentate.....   | 2.                      |
| Hindwings angled, not dentate.....  | 3.                      |
| 2. Hindwings crenulate-dentate.....   | 70. <i>tetralopha</i> . |
| Hindwings strongly produced in an acute tooth on vein 4, not otherwise dentate..... | 71. <i>decorata</i> .   |
| 3. Wings with pale green basal blotches.....  | 72. <i>venusta</i> .    |
| Wings without basal blotches.....   | 4.                      |
| 4. Abdomen with metallic crests, ♂ antennal ciliations 1½.                          | 73. <i>militaris</i> .  |
| Abdomen without metallic crests, ♂ antennal ciliations ¾                            | 74. <i>ametalla</i> .   |

#### 70. METALLOCHLORA TETRALOPHA.

*Euchloris*(?) *tetralopha* Low., Proc. Linn. Soc. N. S. Wales, 1898, p.43.

♂♀. 25-28 mm. Crown and fillet pale yellowish-green; face fuscous-red. Palpi in ♂ 1, terminal joint minute; in ♀ 1½, terminal joint ½; fuscous-red, beneath whitish. Antennæ dull purple, towards base whitish; ciliations in ♂ 1½. Thorax pale yellowish-green. Abdomen, basal segments and tuft pale yellowish-green; middle segments whitish densely irrorated with purple, and with four or five large rounded median purple crests with metallic reflections; beneath ochreous-whitish. Legs brownish-ochreous; posterior pair ochreous-whitish. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique, wavy-crenulate; pale yellowish-green; an ochreous streak along costa strigulated with dark fuscous; a dark fuscous dot on end of cell at ¾; a line of cells showing unctuous reflections from midcosta through discal dot to near base, there bent in a V to

end on dorsum at  $\frac{2}{3}$ ; a similar subterminal line parallel to termen, preceded and followed by a few scattered purplish scales; a broad obscure dark median shade from dorsum beyond middle, sinuate, not reaching costa; a dull purple spot on tornus; a blackish terminal line; cilia whitish, basal third pink. Hindwings with termen dentate-crenulate, with a more prominent tooth on vein 4; colour and markings as forewings, but antemedian line and discal dot obsolete. Underside green-whitish; forewings with a tornal fuscous spot, hindwings with a larger apical spot; cilia mostly fuscous.

N.Q.: Kuranda, 5, 6, 7, 9.

#### 71. METALLOCHLORA DECORATA.

*Thalerura*(?) *decorata* Warr., Nov. Zool. 1896, p.369.

♂. 26-28 mm. Crown dull olive-green; fillet yellow; face yellow, upper and lower margin orange-red. Palpi in ♂ 1 $\frac{1}{2}$ , terminal joint minute; white, upper surface except apex orange-red. Antennae dull reddish, towards base yellow; ciliations in ♂ 1 $\frac{1}{2}$ . Thorax and abdomen dull olive-green; the latter with two or three fuscous-reddish median dorsal dots; beneath whitish. Legs whitish. Forewings triangular, costa gently arched, apex acute, termen straight, oblique; dull olive-green; sometimes with sparsely scattered fuscous scales; a fine fuscous costal line, towards apex interrupted; a fuscous spot becoming orange-red on margin of dorsum at  $\frac{2}{3}$ , with several similar minute dots on veins representing antemedian line; a similar but more numerous series of dots on veins at  $\frac{2}{3}$  representing postmedian line; a fine fuscous-reddish terminal line; cilia white, with a slight reddish suffusion at apex and tornus. Hindwings with termen produced in a long very acute tooth on vein 4, straight on each side of tooth; colour and markings as forewings, but first line obsolete; a linear fuscous-reddish discal mark; second line angled, or obsolete; costal edge of tooth whitish; cilia on tooth reddish; a fuscous dot on cilia on each side of base of tooth. Underside green-whitish, with fuscous spots on cilia.

at apex and tornus of forewing, and fuscous cilia on tooth of hindwing.

N.Q.: Cooktown; Kuranda, 3, 5, 10, 11.

## 72. METALLOCHLORA VENUSTA.

*Chrysomphe venusta* Warr., Nov. Zool. 1896, p.365.

♂♀. 32-38 mm. Crown yellowish-green; fillet and face purple. Palpi in ♂ 1, terminal joint minute; in ♀ 2, terminal joint  $\frac{1}{2}$ ; purple, beneath white. Antennae ochreous-purple; ciliations in ♂  $1\frac{1}{2}$ . Thorax yellowish-green. Abdomen yellowish-green, with three rounded median golden-metallic dorsal crests; tuft, sides, and under-surface whitish. Legs whitish. Forewings triangular, costa gently arched towards apex, termen slightly sinuate, oblique; dull olive-green; an irregularly rounded basal patch of paler yellowish-green projecting in middle to centre of disc; costal edge green-whitish with some reddish-fuscous strigulations; lines thick, curved, not dentate, greenish-yellow; first at  $\frac{1}{3}$ , obscured in basal blotch; second from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum; terminal edge green-whitish; cilia green-whitish, towards apices paler. Hindwings obtusely angled on vein 4; colour and markings as forewings. Underside whitish.

N.Q.: Cooktown; Kuranda, 5, 9, 10, 11, 12.

## 73. METALLOCHLORA MILITARIS.

*Iodis militaris* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.295; *Metallochloa dotata* Warr., Nov. Zool. 1896, p.367; *Metallochloa flavifimbria* Warr., Nov. Zool. 1896, p.367; *Metallochloa differens* Warr., Nov. Zool. 1897, p.41.

♂♀. 24 mm. Crown bright green, fillet whitish-yellow, face fuscous-purple. Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; fuscous-purple, beneath white. Antennae whitish or yellowish; ciliations in ♂ 2. Thorax bright green. Abdomen bright green, with three or four rounded golden-metallic median dorsal crests margined with fuscous-purple; tuft, sides, and undersurface whitish. Legs whitish. Forewings triangular, costa slightly arched, apex round-pointed,



termen straight, oblique; bright green; a fine ochreous streak, interrupted by fuscous dots, along costa; lines obsolete; a fuscous or reddish median discal dot at  $\frac{1}{2}$ ; a similar dot on vein 6 at  $\frac{2}{5}$ ; a terminal series of dark fuscous dots between veins, that at apex larger; cilia whitish-yellow. Hindwings with termen angled on vein 4; colour and markings as forewings, but without subapical dot. Underside green-whitish.

N.Q.: Kuranda, 4, 5; Cairns, 6; Geraldton; Mackay—Q.: Bundaberg; Nambour, 5; Brisbane. Also from Tenimber Islands.

74. *METALLOCHLORA AMETALLA*, n.sp. [*ἀμεταλλος*, not metallic.]

♂. 22-24 mm. Crown bright green; fillet ochreous; face ochreous with a few dark purple scales. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; fuscous-reddish, beneath white. Antennæ ochreous-whitish, towards apex purplish-tinged; in ♂ serrate, ciliations 1. Thorax and abdomen bright green, the latter with a median whitish line on middle segments; tuft, sides, and undersurface whitish. Legs whitish. Forewings triangular, costa slightly arched towards apex, apex round-pointed, termen slightly bowed, oblique; bright green; a fine ochreous costal line interrupted by dark fuscous dots; lines obsolete; a fuscous or reddish median discal dot at  $\frac{1}{2}$ ; a similar dot on vein 6 at  $\frac{2}{5}$ ; a median and postmedian series of slightly paler blotches with darker edges of groundcolour; a terminal series of dark fuscous dots between veins, that at apex larger; cilia whitish-yellow. Underside green-whitish.

Closely allied to *M. militaris*, but the different structure of the ♂ antennæ is sufficient to remove any doubt as to its distinctness. Type in Coll. Turner.

N.A.: Port Darwin; in September and October; two specimens, of which one is in Coll. Lyell.

Gen. 21. *UROLITHA*.

*Urolitha* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 861.

Face smooth. Tongue well developed. Palpi in ♂ moderate, in ♀ rather long; basal joint hairy, second joint smooth-scaled;

terminal joint in ♂ abbreviated. Antennæ in ♂ ciliated, in ♀ simple. Thorax not crested, slightly hairy beneath. Abdomen sometimes with metallic dorsal crests; in ♂ with lateral tufts on terminal segments. Posterior tibiae in ♂ dilated; all spurs present. Hindwings with termen straight and long, forming a rounded projection at tornus containing a dark spot; a strong rounded costal expansion at base; frenulum in ♂ present but rather slender, in ♀ obsolete. Forewings with 3 and 4 short-stalked or connate, 6 short-stalked or connate, 11 free or rarely anastomosing with 12. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 touching cell at a point near base, then rapidly diverging; discocellulars nearly straight, moderately oblique.

Type *Iodis bipunctifera* Wlk. Closely allied to *Metallochloa* Warr., differing only in the peculiar form of the hindwings, which in this instance appears to be sufficient, also by the lateral abdominal tufts of ♂. The occasional presence of metallic crests on the abdomen is an interesting indication of affinity. They are usually completely absent.

#### 75. UROLITHA BIPUNCTIFERA.

*Iodis bipunctifera* Wlk., Cat. Brit. Mus. xxii., p.546; *Urolitha bipunctifera* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.866.

Antennal ciliations in ♂  $1\frac{1}{2}$ . Palpi in ♂  $1\frac{1}{4}$ , terminal joint very short; in ♀ 2, terminal joint  $\frac{1}{2}$ .

Q.: Brisbane, 1, 2, 3, 4; Stradbroke Island, 4, 9—N.S.W.: Newcastle; Sydney, 9, 10, 11.

Gen.22. ARGYROSCOMA, n.g.[ἀργυροκοσμος, adorned with silver.]

Face smooth. Tongue well developed. Palpi in ♂ moderate, in ♀ long; second joint well developed, and thickened with rough scales beneath in both sexes; terminal joint in ♂ abbreviated, in ♀ long. Antennæ in ♂ with long pectinations, in ♀ simple. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiae with all spurs present, rather closely approximated, in ♂ with a short terminal process. Hindwings with a rounded costal expansion at base; frenulum in ♂ present but

slender, retinaculum near base of forewing; frenulum in ♀ obsolete. Forewings with 3 and 4 remote at origin, 3 being from well before angle, 6 separate, 11 long-stalked with 7, 8, 9, 10, not anastomosing, discocellular oblique and separate on vein 5. Hindwings with 3 and 4 remote at origin, 6 and 7 stalked, 8 approximated to cell at a point near base, rapidly diverging; discocellulars widely separate on vein 5 (or twice-angled), dorsal strongly oblique, costal edge of cell considerably over  $\frac{3}{4}$ .

The neurulation, which appears to be constant, is highly peculiar in the remote origin of 3 and 4 of both wings, the long-stalking of vein 11, and the twice-angled discocellulars. Type *Euchloris argosticta* Turn.

#### 76. ARUYROCOSMA ARGOSTICTA.

*Euchloris argosticta* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 220.

Antennal pectinations in ♂ 12. Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀ 3, terminal joint  $\frac{3}{4}$ .

N.A.: Port Darwin, 10—N.Q.: Kuranda, 9; Townsville, 1, 2, 3, 7.

#### Gen. 23. CHRYSOCHLOROMA.

*Chrysochloroma* Warr., Nov. Zool. 1896, p. 288.

Head smooth. Tongue well developed. Palpi in ♂ moderate, in ♀ long, ascending, terminal joint in ♂ much shortened and bent downwards. Antennae in ♂ pectinate, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax densely hairy beneath. Posterior tibiae with outer proximal spur much shortened or absent in ♂. Hindwings quadrate, strongly angled, or slightly produced on vein 4; with a moderate costal expansion at base, frenulum and retinaculum in ♂ strongly developed; frenulum in ♀ represented by a weak tuft of scales. Forewings with 3 and 4 separate or connate, 6 connate or stalked, 11 free. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 approximated to cell for some distance, diverging before middle.

Type, *Chrysochloroma meeki* Warr., from the Trobriand Islands, off New Guinea.

A small natural genus, which lies near the borderland of the first two groups. There is only a moderate costal expansion at base of forewings; and, while the ♂ frenulum is strongly developed, the weak tuft of scales representing it in ♀ is not always discernible. The peculiar form of the hindwings and ♂ palpi are good distinguishing features. The bending of veins 12 and 11 described by Warren is strongly marked in *C. megaloptera*, less so in *C. orthodesma*, but I do not consider it an important character.

1. Line on wings slender..... 77. *megaloptera*.  
 Lines dilated into fasciæ ..... 78. *orthodesma*.

#### 77. CHRYSOCHLOROMA MEGALOPTERA.

*Euchloris megaloptera* Low., Trans. Roy. Soc. S. Austr., 1894, p.87; *Chrysochloroma subalbida* Warr., Nov. Zool. 1896, p.364; *Euchloris hypoleucus* Low., Proc. Linn. Soc. N. S. Wales, 1897, p.263.

♂♀. 40-47 mm. Head green; fillet broadly white; face reddish-brown, lower third brown-whitish, the darker colour forming a median tooth. Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀ 3, terminal joint  $\frac{2}{3}$ ; reddish-brown, beneath white. Antennæ white, apices ochreous-whitish, pectinations tinged with green. Thorax and abdomen green, tuft, sides, and under-surface whitish. Legs whitish; anterior pair, except coxæ and middle tibiae, and first joints of tarsi green on upper surface in ♂, brownish in ♀. Forewings triangular, costa straight, strongly arched towards apex, apex acute, slightly produced, costa slightly bowed, oblique, very slightly wavy; bright green; a snow-white streak along costa nearly from base, which is edged with dark purple near apex; lines pale green, slender, converging not dentate; antemedian from  $\frac{1}{3}$  dorsum, not reaching costa; postmedian from or from before  $\frac{2}{3}$  dorsum to beneath costa at  $\frac{2}{3}$ , nearly straight; a ferruginous-fuscos discal dot on end of cell; cilia white with a median purple line. Hindwings as forewings but with antemedian line obsolete, and discal dot rather larger. Underside whitish-green, forewings rather darker.

Type *C. megaloptera* in Queensland Museum; type *E. hypoleucus* in Coll. Lyell.

N.A.: Port Darwin, 10—N.Q.: Cooktown; Laura; Townsville, 12. Mr. Dodd has found the larvæ in the nests of the green tree-ant.

#### 78. CHRYSOCHLOROMA ORTHODESMA.

*Euchloris orthodesma* Low., Trans. Roy. Soc. S. Austr. 1894, p. 86.

Q. 34-38 mm. Head and face bluish-green; fillet narrowly white. Palpi in ♀ 2, terminal joint  $\frac{1}{2}$ ; bluish-green. Antennæ brown-whitish, towards base white. Thorax and abdomen bluish-green; beneath whitish. Legs whitish; anterior tibiæ and tarsi brownish. Forewings triangular, costa gently arched, apex acute, termen slightly bowed, oblique; bluish-green; costal edge whitish-ochreous; an inwardly-oblique, broad, suffused, bluish-white median fascia, containing a median dark green discal dot; a similar fascia, slightly waved, before and parallel to termen; cilia pale green. Hindwings as forewings, but second fascia touching termen on dorsal side of angle. Undersurface whitish-green. Type in Queensland Museum.

N.Q.: Cairns; Kuranda, 4, 5, 9.

#### Gen. 24. APODASMA, n.g. [*ἀποδάσμιος*, parted from.]

Face smooth, slightly projecting at lower edge. Tongue well developed. Palpi moderately long, porrect; second joint rough-haired above and beneath; terminal joint short in both sexes. Antennæ serrate and ciliated in both sexes; ciliations longer in ♂. Thorax and abdomen not crested; thorax slightly hairy beneath. Posterior tibiæ with middle spurs present; in ♂ not dilated, but with inner terminal spur absent. Hindwings with a strong rounded costal expansion at base beyond origin of frenulum; frenulum in ♂ present but weak, retinaculum small and close to base of forewing; frenulum in ♀ represented by a tuft of long hairs. Forewings with 3 and 4 separate, 6 separate, 11 anastomosing with 12 and 10. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 closely approximated to near middle of cell,

then diverging; discocellulars slightly angled on vein 5, slightly oblique, dorsal curved.

Type, *Fidonia rufonigraria* Wlk. The frenulum in the ♂ is certainly weakly developed, but, contrary to the usual rule, that in the ♀ is represented by a well marked tuft of hairs. It must certainly be separated from *Epipristis* Meyr., as it has no close affinity to *E. minimaria* Gn. Minor peculiarities are the longer approximation of vein 8 of hindwings to cell, the hairy palpi, serrate antennæ, and absence of inner terminal spur in hindleg of ♂.

#### 79. APODASMIA RUFONIGRARIA.

*Fidonia*(?) *rufonigraria* Wlk., Cat. Brit. Mus. xxiv. p.1036: *Epipristis rufonigraria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.916.

Palpi 2; terminal very short and alike in both sexes. Antennal ciliations in ♂ 1.

Q.: Brisbane—N.S.W.: Sydney, 9—Vic.: Gisborne, 11—W.A.: Bridgetown, 4.

#### (Gen.25. ULIOCNEMIS.

*Uliocnemis* Warr., Proc. Zool. Soc. 1893, p.355; Hmps., Moths Ind. iii. p.487.

Face slightly roughed-scaled. Tongue present. Palpi rather long, ascending; second joint long, roughly hairy beneath; terminal joint bent forwards and porrect, in ♂ short. Antennæ pectinated in both sexes, apices simple. Thorax with a strong posterior crest; beneath hairy. Abdomen with a series of median dorsal crests. Posterior tibiæ with middle spurs absent in ♂, not dilated and without terminal process. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ well developed; frenulum in ♀ (not examined). Forewings with 3 and 4 separate, 6 separate, connate, or short-stalked, 11 free. Hindwings with 3 and 4 connate or short-stalked, 6 and 7 connate or stalked, 8 approximated to cell near base, rapidly diverging; discocellulars scarcely angled, dorsal curved so as to become rather strongly oblique; costal edge of cell considerably over  $\frac{1}{2}$ .

Type, *Phorodesma cassidara* Gn., from Ceylon, in which species, as Mr. L. Prout informs me, the middle spurs of ♂ are wholly absent. The variability of veins 6 and 7 of the hindwing in the same species is exceptional. This character is usually constant in each genus.

#### 80. ULIOCNEMIS PARTITA.

*Comibæna partita* Wlk., Cat. Brit. Mus. xxii. p.573; Butl., Ill. Het. vi. Pl.117, f.11: *Comibæna felicitata* Wlk., Cat. Brit. Mus. xxii. p.579; *Thalera concisiplaga* Wlk., Cat. Brit. Mus. xxii. p.598; *Iodis partita* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.892; *Uliocnemis partita* Hmps., Moths Ind. iii. p.488.

Palpi in ♂ 2, terminal joint minute. Antennal pectinations in ♂ 10.

N.Q.: Prince of Wales Island, 6; Kuranda, 3, 5, 6; Townsville, 5—Q.: Brisbane. Also from Borneo and India.

#### Gen.26. AGATHIOPSIS, n.g.

*Agathiopsis* Warr., Nov. Zool. 1896, p.285.

Face smooth. Tongue well developed. Palpi rather short, terminal joint short in both sexes. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax with a strong posterior crest; beneath densely hairy. Abdomen not crested. Posterior tibiae with all spurs present in both sexes, inner fairly long, outer about  $\frac{1}{2}$ . Hindwings without costal expansion at base; frenulum and retinaculum in ♂ [unknown]; frenulum in ♀ obsolete(?). Forewings with 3 and 4 connate, 6 short-stalked, 10 arising from 8 after 7, 11 free. Hindwings with 3 and 4 stalked, 6 and 7 stalked, 8 anastomosing with cell near base, rapidly diverging; discocellulars slightly angled on vein 5, only slightly oblique.

Type, *Agathiopsis maculata* Warr., from the Louisiades. The characters being based on one female specimen are not complete, but sufficient to show that the genus is allied to *Uliocnemis*, but quite distinct.

#### AGATHIOPSIS BASIPUNCTA.

*Agathiopsis basipuncta* Warr., Nov. Zool. 1896, p.285; *Euchloris amphibola* Turn., Trans. Roy. Soc. S. Austr., 1896, p.128.

Palpi in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . For description of the male see Warren, *loc. cit.*

N.Q.: Kuranda, 6, 7. Also from Louisiades.

#### Gen. 27. EUCYCLODES.

*Eucyclodes* Warr., Nov. Zool. 1894, p. 390; *Anisogamia* Warr., Nov. Zool. 1896, p. 286 (*præcox.*).

Face smooth, sometimes with some projecting scales on lower edge. Tongue strongly developed. Palpi in ♂ moderate or rather long, with terminal joint fairly long or abbreviated; in ♀ long. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax and abdomen not crested; thorax densely hairy beneath, usually with a tuft of very long hairs beneath base of forewing. Posterior tibiæ with all spurs present; in ♂ dilated, with a stout terminal process. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a pencil of long hairs. Forewings with 3 and 4 widely separate at origin, 6 connate, 11 usually free, rarely anastomosing with 12, or with 12 and 10; discocellulars strongly incurved. Hindwings with 3 and 4 usually stalked, sometimes connate, 6 and 7 stalked, 8 closely approximated to cell for some distance, sometimes nearly to middle; discocellulars very oblique, usually straight, sometimes slightly angled, with dorsal somewhat curved; costal edge of cell short, usually  $\frac{3}{4}$ , rarely  $\frac{1}{2}$ .

Type, *Phorodesma buprestaria* Gn. The genus is a large one in the Papuan region. Its characteristics are the well developed frenulum in both sexes, the dense woolly hairiness of the underside of the thorax, the wide separation of veins 3 and 4 of the forewings, and the extremely oblique discocellular of hindwing, with consequent abbreviation of the costal edge of the cell. The species are mostly remarkable for the great diversity of colour and markings in the two sexes, a very rare trait in the *Geometridæ*. In *E. metaspila* and *E. buprestaria*, however, the sexes are alike. The larvae of *E. ineperata*, *E. pieroides*, and *E. metaspila* are known. They are very similar, having large flattened projections on both sides of the dorsum of each segment.



It will be most convenient to tabulate the two sexes separately:—

## ♂♂.

1. Hindwings with termen dentate.....	2.
Hindwings with termen rounded or wavy, angled or dentate on vein 4 only.....	5.
2. Forewings with a broad white antemedian line.....	82. <i>pietroides</i> .
Forewings with antemedian line slender or incomplete	3.
3. Forewings with a large white costal spot on origin of antemedian line.....	85. <i>fascians</i> .
Forewings without large white costal spot.....	4.
4. Wings with white median subterminal blotches, and a few white dots.....	86. <i>speciosa</i> .
Wings with very numerous white dots and small spots, no blotches.....	87. <i>callisticta</i> .
5. Cilia green or green and white.....	6.
Cilia mostly reddish or purplish.....	5.
6. Lower third of face white.....	7.
Face green, extreme lower edge only white.....	91. <i>moniliata</i> .
7. Wings with broad straight white postmedian lines.....	88. <i>insperata</i> .
Postmedian lines very slender, curved.....	89. <i>erotyla</i> .
8. Wings with termen brown.....	94. <i>insperstaria</i> .
Wings with termen green.....	9.
9. Face green.....	92. <i>metaspila</i> .
Face red.....	93. <i>saturataria</i> .

## ♀♀.

1. Hindwings with termen dentate.....	2.
Hindwings with termen rounded or wavy, angled or dentate on vein 4 only.....	5.
2. Forewings with a reddish-brown triangular basal blotch	82. <i>pietroides</i> .
Forewings without basal blotch.....	3.
3. Wings with broad uninterrupted terminal band.....	83. <i>dentata</i> .
Wings without terminal band.....	4.
4. Forewings with a grey-whitish apical blotch.....	84. <i>goniata</i> .
Forewings with a fuscous tornal blotch.....	85. <i>fascians</i> .
Forewings without blotches.....	86. <i>speciosa</i> .
5. Face green, or green and white.....	6.
Face red, or brown and white.....	8.
6. Forewings with costa and cilia reddish-brown.....	92. <i>metaspila</i> .
Forewings with costa and cilia mostly grey.....	7.
7. Forewings with apical, midterminal, and tornal blotches.....	88. <i>insperata</i> .
Forewings with narrow terminal line only.....	91. <i>moniliata</i> .

8. Patagia, except at base, purplish.....	92. <i>crymnodes</i> .
Patagia green.....	9.
9. Wings with termen green.....	93. <i>saturataria</i> .
Wings with termen brown.....	94. <i>huprestaria</i> .

82. *EUCYCLODES PIEROIDES*.

*Q. Comibæna pieroides* Wlk., Cat. Brit. Mus. xxii. p.580; *♂*. *Thalassodes scitissimaria* Wlk., Cat. Brit. Mus. xvi. p.1564; *Comibæna calcinata* Feld., Reise Nov. Pl.127, f.23; *Iodis pieroides* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.897.

Antennal pectinations of *♂* 2½. Palpi in *♂* 2, terminal joint ½; in *♀* 3, terminal joint ¾. Discocellulars of hindwing nearly straight.

The larvæ are found in gardens on roses.

N.Q.: Townsville, 3, 4, 5, 6; Stannary Hills—Q.: Duaringa; Rockhampton; Gympie; Brisbane, 3, 4, 5, 10; Stradbroke Island.

83. *EUCYCLODES DENTATA*.

*Anisogamia dentata* Warr., Nov. Zool. 1897, p.34.

*♂*. Unknown.

*♀*. 36 mm. Crown and fillet whitish irrorated with brown and dark fuscous, and posteriorly also with green; face green, lower edge with a broad white streak tending to be interrupted. Palpi 3, terminal joint ¾; pale brown, beneath white, terminal joint annulated with dark fuscous. Antennæ brown-whitish. Thorax green; a broad posterior median streak from middle whitish irrorated with brown and dark fuscous. Abdomen whitish irrorated with brown and dark fuscous, with some green on basal segments. Legs ochreous-whitish; anterior tibiae and tarsi broadly annulated with dark fuscous. Forewings triangular, costa strongly arched, apex rounded, termen bowed, oblique, strongly dentate; green, thinly scaled, with slight obscure whitish strigulations; a broad costal streak brown-whitish irrorated and chequered with dark fuscous; a transverse irregularly oval whitish spot before middle, its margins irrorated with fuscous, touching costal streak; a broad terminal band with rounded

dilatations above middle and on tornus, reddish-brown with some fuscous scales; cilia grey-whitish. Hindwings strongly dentate, with more prominent teeth on veins 4 and 6; discocellulars nearly straight; as forewings but without discal spot; some white dots on basal veins; terminal band thickened at apex and above middle, narrower at tornus. Underside green-whitish; a dark fuscous subterminal band, outwardly dentate, inwardly with rounded projections as on upper side.

N.Q.: Cooktown; Cairns, 8; Kuranda, 4, 5.

#### 84. EUCYCLODES GONIOTA.

*Euchloris goniota* Low., Trans. Roy. Soc. S. Austr., 1894, p.86;  
*Anisogamia curvigutta* Warr., Nov. Zool. 1897, p.34.

♂. Unknown.

Q. 32 mm. Crown, fillet, and face whitish-ochreous with some brownish scales. Palpi  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; pale brownish, beneath whitish. Antennæ whitish-grey. Thorax green, some hairs in tegulae and a large posterior spot whitish-ochreous. Abdomen whitish-ochreous with a few brownish scales, under-surface whitish. Legs whitish; anterior tibiae and tarsi fuscous with whitish annulations. Forewings triangular, costa rather strongly arched, apex round-pointed, termen bowed, oblique, crenulate; green with a few obscure whitish strigulae; a fuscous costal streak strigulated with whitish-ochreous; a fine, slender, waved, whitish antemedian line from  $\frac{1}{4}$  costa to  $\frac{2}{3}$  dorsum; an ochreous-whitish apical blotch reaching to midtermen, its lower extremity showing a rounded dilatation, irrorated sparsely with fuscous and including a terminal series of fuscous lunules between veins; a series of ochreous-whitish dots on terminal ends of veins between apical blotch and tornus; cilia green, on costal blotch and terminal dots ochreous-whitish tinged with grey. Hindwings with termen dentate, with stronger teeth on veins 4 and 6; as forewings but without antemedian line; apical blotch similar but more elongate. Underside green-whitish; a brownish-fuscous spot on apex of both wings.

My description is taken from the type, which is in the Queensland Museum.

N.Q.: Mackay.

#### 85. EUCYCLODES FASCINANS.

*Iodis fascinans* Luc., Proc. Linn. Soc. N. S. Wales, 1893, p.138.

♂. 32-36 mm. Crown green; fillet green edged with white anteriorly; face green with a broad white streak on lower edge, partly interrupted. Palpi 2. terminal joint  $\frac{1}{2}$ ; pale brownish or fuscous, apices of joints and undersurface white. Antennæ grey, base of stalk white; pectinations  $3\frac{1}{2}$ . Thorax green; a large white posterior spot including a pair of green dots. Abdomen green, with a median and a lateral series of white dots, which may be mixed with fuscous, and may be lost posteriorly in a general white irroration; tuft and undersurface white. Legs white; anterior tibiae and tarsi broadly barred with dark fuscous in front. Forewings triangular, costa moderately arched, apex rounded, termen bowed, oblique, moderately dentate; green, rather strongly scaled, with numerous fine transverse white strigulae, sometimes reduced to dots on veins; a fuscous streak strigulated with white on costa beyond middle; a large white spot touching costa at  $\frac{2}{5}$ , from which sometimes proceeds a fine waved line to  $\frac{2}{5}$  dorsum; a similar but smaller spot at  $\frac{3}{5}$ , giving rise to a dentate interrupted postmedian line; this is succeeded by similar subterminal and submarginal spots and lines, the last line consisting of a series of spots only; a terminal series of white dots on veins; cilia green, apices opposite dots white. Hindwings with termen rounded and dentate; discocellulars nearly straight; as forewings but without antemedian spot and line; base and dorsum sometimes with confluent strigulae; a large ochreous or brown apical spot, margined with white, sometimes containing an interrupted fuscous line. Underside green-whitish; a dark fuscous apical spot on hindwing; sometimes a greenish-fuscous line emitting three processes on apex of forewing.

♀. 28 mm. Differs as follows—Palpi  $3\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Abdomen fuscous; basal segment green; a series of median dorsal

dots and undersurface white. Wings green, with obscure whitish strigulae but without white spots. Forewings with a fuscous streak along whole of costa, a large fuscous spot on dorsum near base, another before termen above middle, and a third, smaller, on tornus. Hindwings with a fuscous apical blotch. The underside is similarly marked.

Though rather small, this ♀, of which there is one example from Kuranda, in Coll. Lyell, is, I think, to be referred to this species, though it is just possible that it may belong to *E. callisticta*.

N.Q.: Kuranda, 4, 5, 11, 12—Q: Brisbane, 1.

#### 86. EUCYCLODES SPECIOSA.

♀. *Iodis speciosa* Luc., Proc. Linn. Soc. N. S. Wales, 1889, p. 1094;  
♂. *Euchloris chionoplaca* Low., Trans. Roy. Soc. S. Austr., 1893,  
p. 288; ♂♀. *Anisogamia albimacula* Warr., Nov. Zool. 1897, p. 33;  
♂. *Iodis sideralis* Luc., Proc. Roy. Soc. Qld., 1898, p. 68.

♂. 35 mm. Crown and fillet green; face green, with a broad interrupted white line on lower edge. Palpi 2, terminal joint  $\frac{1}{2}$ ; dull green, extreme apex and undersurface white. Antennae gray-whitish; basal joint fuscous-brown, its anterior surface and extreme apex white; pectinations 3. Thorax green, with a large white posterior spot edged with fuscous. Abdomen green; with a fuscous-brown dorsal spot about middle; anterior to this are three minute white median dots, posterior a small fuscous spot immediately succeeded by a large white blotch; tuft and undersurface white. Legs white; anterior tibiae and tarsi fuscous barred with white in front; posterior tibiae with a stout terminal process. Forewings triangular, costa moderately arched, apex bowed, oblique, crenulate; green, rather thinly scaled, with a few scattered whitish strigulae; a fuscous streak along costa, interrupted by white strigulae; a minute white dot beneath costa at base; a fine wavy white antemedian line, from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum, towards dorsum edged on both sides with fuscous; postmedian line represented by a series of white dots on veins at  $\frac{1}{2}$ , joined in middle by a similar series of dots from apex; above

confluence and between veins 3 and 4 is a large white spot narrowly margined with fuscous; a terminal series of very distinct white dots on veins; cilia green, apices white. Hindwings with termen rounded and moderately dentate; discocellulars nearly straight; as forewings but without antemedian line; the large white spot is placed across vein 3, and there are two small white dots between it and termen. Underside green-whitish; a fuscous streak strigulated with whitish along costa of forewing.

♀. 38 mm. Differs as follows—Palpi 3, terminal joint  $\frac{1}{2}$ . Spots on thorax and abdomen more broadly outlined with fuscous; no white blotch on abdomen; penultimate abdominal segments fuscous. White spot on forewings reduced to a linear mark, and that on hindwings absent. Terminal dots on both wings ochreous-whitish outlined with fuscous-brown. An elongate fuscous spot with a brown centre on apex of hindwing. Cilia on terminal spots pale fuscous.

These descriptions are from Brisbane examples. A pair from Kuranda shows, in the male, more irregularly shaped white blotches and smaller terminal dots; no white blotch on abdomen, but middle segments fuscous; in the female, absence of brown apical spot on hindwing, and of brown outlines around terminal dots. Evidently the species is variable within limits.

N.Q.: Cooktown; Geraldton; Kuranda, 5, 6; Mackay—Q.: Brisbane.

#### 87. *EUCYCLODUS CALLISTIOTA*.

*Euchloria callistiota* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 222.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Antennal pectinations in ♂ 4. Discocellulars of hindwing not angled, dorsal curved. Posterior tibiae of ♂ with terminal process unusually long, exceeding  $\frac{1}{2}$  tarsus.

♀. Unknown.

N.Q.: Kuranda, 3, 4, 5, 11, 12.

88. *EUCYCLODES INSUPERATA*.

*Thalassodes insuperata* Wlk., Cat. Brit. Mus. xxii. 555; *Iodis insuperata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 895.

Antennal ciliations of ♂ 2½. Palpi in ♂ 1½, terminal joint ¼; in ♀ 2, terminal joint ¼. Discocellulars of hindwing nearly straight.

N.Q.: Mareeba, 12—Q.: Brisbane, 4, 8; Stradbroke Island, 10; Southport—N.S.W.: Newcastle; Sydney—Vic.: Melbourne—Tas.: George's Bay.

89. *EUCYCLODES EROTYLA* n.sp. [*έρωτυλος*, a darling.]

♂. 29 mm. Crown green with a white posterior spot; fillet narrowly white; face green, lower third and lateral edges white. Palpi fuscous, beneath white; in ♂ 1½, terminal joint ¼. Antennae white, sharply barred with fuscous on dorsum, towards apex grey; pectinations in ♂ 2. Thorax green; a broad white fascia from before middle, containing laterally paired green spots behind middle. Abdomen green, a series of median dorsal spots, tuft, sides, and under surface white. Legs white; anterior femora fuscous anteriorly, anterior tibiae and tarsi fuscous annulated with white. Forewings triangular, costa rather strongly arched, apex round-pointed, termen bowed, oblique, very slightly wavy; green with numerous white transverse strigulae; a broad fuscous costal streak spotted and strigulated with white; transverse lines very slender, curved, white mixed with pale fuscous; antemedian from ¼ costa to ⅔ dorsum; postmedian from ⅓ costa, shortly bifurcated above dorsum, one branch ending on ⅔ dorsum, the other just before tornus; subterminal similar but interrupted; one or two small white spots just above tornus; three or four white terminal dots on veins; cilia green, apices white. Hindwings with termen wavy, angled and toothed on vein 4; discocellulars slightly angled on vein 5, dorsal curved; as forewings but antemedian line obsolete, and white strigulae very pronounced on dorsum. Underside whitish. Type in Coll. Turner.

♀. Unknown.

Q.: Brisbane: in May; one specimen received from Mr. R. Illidge.

90. *EUCYCLODES ERYMNODES*, n.sp. [*ἐρυμνῶδης*, like a fortification.]

♂. Unknown.

♀. 28 mm. Crown and face dull purplish mixed with white; fillet white. Palpi slender; dull purplish, beneath white; in ♀ 3-terminal joint  $\frac{1}{2}$ . Antennae grey. Thorax dull purplish; tegulae and bases of patagia green. Abdomen dull purplish, some obscure median dorsal dots, apex, sides, and undersurface white. Legs white; anterior tibiae and tarsi pale fuscous. Forewings triangular, costa rather strongly arched, apex round-pointed, termen bowed, oblique, very slightly wavy; pale green; a basal fascia prolonged as a broad costal streak dull purplish; the costal streak shows a strong triangular tooth in disc at  $\frac{1}{3}$ ; continuous with costal streak is a terminal fascia of the same colour, showing a large rounded expansion in middle, and another on tornus; these expansions are paler, ochreous tinged with some pale fuscous irroration; a dark purplish terminal line interrupted on veins; cilia ochreous-whitish with some purplish tinge. Hindwings with termen wavy; angled and toothed on vein 4; discocellulars nearly straight; as forewings but without costal streak; terminal fascia expanded at apex and beneath middle. Undersurface whitish. Type in Coll. Lyell

N.Q.: Kuranda: in June; one specimen received from Mr. F. P. Dodd.

#### 91. *EUCYCLODES MONILIATA*.

♀. *Anisogamia moniliata* Warr., Nov. Zool. 1897, p.34; ♂. *Anisogamia undilinea* Warr., Nov. Zool. 1897, p.35.

♂. 30 mm. Crown green; fillet broadly snow-white; face green, lower edge with a white streak, sometimes interrupted in middle. Palpi  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; green, beneath white. Antennal stalk white; pectinations  $2\frac{1}{2}$ , grey. Thorax green, with a median and two posterior white spots. Abdomen green, median dorsal spots, tufts, sides, and undersurface white. Legs white; anterior



pair ochreous-grey in front; posterior tibiae with a very stout terminal process. Forewings triangular, costa moderately arched, apex round-pointed, termen bowed, oblique, scarcely wavy; bright green; a white streak along costa, sparsely irrorated with pale fuscous; lines slender, white, sharply dentate, sometimes interrupted; antemedian from  $\frac{1}{4}$  costa to  $\frac{2}{3}$  dorsum; postmedian from beneath  $\frac{3}{4}$  costa, first outwardly curved, then bent inwards to  $\frac{2}{3}$  dorsum; a terminal series of white dots on veins; cilia green, apices grey-whitish. Hindwings with termen wavy, bent and slightly toothed on vein 4; discocellulars nearly straight; as forewings but without basal line, and with some white dots on basal veins. Underside whitish; costal area of forewing suffused with green; costal edge of forewing white, with an ochreous subcostal streak towards base.

♀. 32-36 mm. Head as in ♂. Palpi  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; pale brown, beneath whitish. Antennae pale brown, towards base white. Thorax green, a broad posterior median band extending to middle brown mixed with whitish. Abdomen brown mixed with whitish, base green, undersurface whitish. Legs ochreous-whitish; anterior pair grey in front. Wings shaped as in ♂. Forewings green; a broad costal streak whitish densely irrorated with pale fuscous; antemedian line as in ♂; postmedian line obsolete; a small whitish linear discal dot at  $\frac{1}{3}$ ; a fine ochreous-whitish terminal band, very slender in middle, anteriorly interruptedly edged with fuscous-brown; cilia ochreous-whitish. Hindwings as forewings but without antemedian line. Underside green-whitish; costal edge of forewings pale brownish.

There need be no doubt, I think, as to these forms being sexes of the same species.

N.Q.: Cooktown; Kuranda, 2, 5, 10.

## 92. EUCYCLODRE METASPILA.

*Comibana metaspila* Wlk., Cat. Brit. Mus. xxii. p.580; *Iodis metaspila* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.895; *Iodis eucalypti* Luc., Proc. Linn. Soc. N. S. Wales, 1888, p.1267.

Antennal pectinations of ♂  $2\frac{1}{2}$ . Palpi in ♂  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Discocellulars of hindwing slightly angled on vein 5; dorsal curved.

N.Q.: Cairns, 8—Q.: Toowoomba, 11; Brisbane.

#### 93. †EUCYCLODES SATURATARIA.

*Chlorochroma saturataria* Wlk., Cat. Brit. Mus. xxxv. p.1609;  
*Iodis saturataria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.895.

I have seen only the type (♀) in the British Museum, sent by Mr. Diggles, and probably taken in the neighbourhood of Brisbane. It seems closely allied to *E. metaspila*, and probably the sexes are similar as in that species.

#### 94. EUCYCLODES BUPRESTARIA.

*Phorodasma buprestaria* Gn., Lep. ix. p.371, Pl.vii. f.4: *Iodis buprestaria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.890.

Antennal pectinations in ♂ 2. Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Discocellulars of hindwing very slightly angled on vein 5, dorsal slightly curved.

N.S.W.: Sydney, 11—Vic.: Melbourne, 11; Nhill, 9.—Tas.: Launceston.

#### Gen.28. CHLORODES.

*Chlorodes* Gn., Lep. ix. p.378.

Face smooth. Tongue well developed. Palpi in both sexes  $1\frac{1}{2}$ ; second joint roughly hairy above and beneath; terminal joint equally short in both sexes. Antennae in ♂ pectinate, extreme apices simple; in ♀ simple. Thorax and abdomen not crested; thorax hairy beneath. Posterior tibiae with all spurs present; in ♂ not dilated and without terminal process. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a tuft of long hairs. Forewings with 3 and 4 well separated at origin, 6 short-stalked, 11 free, or anastomosing with 12 only, or with both 12 and 10; discocellulars scarcely incurved, nearly straight. Hindwings with 3 and 4 slightly separate or nearly connate, 6 and 7 long-

stalked, 8 closely approximated to cell, sometimes nearly as far as middle, then gradually diverging; discocellulars but slightly angled, or nearly straight, moderately or rather strongly oblique; costal edge of cell considerably over  $\frac{2}{3}$ .

Type, *Chlorodes boisduvalaria* Le G. The separation of 3 and 4 is better marked in the forewing, which is unusual. The roughly hairy palpi are another peculiarity, as is the pectination of the  $\delta$  antennæ nearly to apex. Structurally this genus comes near *Terpna*, with the important exception of the stalking of 6 and 7 of the hindwings.

#### 95. CHLORODES BOISDUVALARIA.

*Geometra boisduvalaria* Le G., Rev. Zool. 1841, p.257; *Chlorodes mirandaria* Gn., Lep.ix. p.379, Pl.v. f.7; *Iodis boisduvalaria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.892.

Vic: Gisborne, 2; Mt. St. Bernard, 2—Tas.: Launceston.

I have seen a drawing, by Mr. A. Simson of Launceston, of the larva of this species. It has paired dorsal processes on each segment, analogous to those of *Eucyclodes*.

#### Gen.29. AGATHIA.

*Agathia* Gn., Lep.ix. p.380; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.899; Hmps., Moths Ind. iii. p.485.

Face rounded, strongly convex, smooth. Tongue well developed. Palpi rather long in  $\delta$ , longer in  $\phi$ ; basal joint as long as second joint; terminal joint in  $\delta$  very short, in  $\phi$  elongate. Antennæ simple in both sexes, in  $\delta$  minutely ciliated. Thorax not crested; hairy beneath. Abdomen sometimes smooth, sometimes with small median dorsal crests; in  $\delta$  with large tuft and lateral crests on terminal segments, and with an extrusible tuft of hairs near base on ventral surface. Posterior tibiae with all spurs present; in  $\delta$  dilated, with a groove containing hairs on inner surface, and a short stout terminal process. Hindwings with a long acute tooth on vein 4; without basal costal expansion; frenulum and retinaculum in  $\delta$  well developed; frenulum in  $\phi$  represented by a tuft of long hairs. Forewings with 3 and

4 separate but approximated at origin, 6 separate, 11 free or rarely anastomosing with 12. Hindwings with 3 and 4 separate but approximated at origin, 6 and 7 separate but approximated, 8 anastomosing with cell near base, closely approximated to  $\frac{1}{2}$ , then diverging; discocellulars scarcely angled, scarcely oblique except lower end of dorsal, which is strongly curved.

Type, *A. lycenaria* Koll., from India, China, Java, and Borneo.

#### 96. AGATHIA LÆTATA.

*Phalaena lætata* Fabr., Ent. Syst. iii. 2, p.164; Moore, Lep. Ceyl. iij. Pl.197. f.1: *Agathia hilarata* Gn. Lep ix. p.381; *Agathia catenaria* Wlk., Cat. Brit. Mus. xxii. p.591; *Agathia quinaria* Moore, Proc. Zool. Soc. 1867, p.639; *Agathia carissima* Butl., Ill. Het. ii. p.50, Pl.36, f.7; *Agathia lycenaria* von Hedeman, Hor. Soc. Ent. Ross. xiv. p.512, Pl.iii. f.4; *Agathia asterias* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.899; *Agathia prasinaspis* Meyr., Trans. Ent. Soc. 1889, p.495; *Agathia prasina* Swin., Ann. Mag. Nat. Hist. (6) xii. p.219; *Agathia iodioides* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.296; *Agathia distributa* Luc., op. cit. 1891, p.296; *Agathia lætata* Hmps., Moths Ind. iii. p.487; *Agathia disconnecta* Warr., Nov. Zool. 1896, p.362.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute; in ♀ 3, terminal joint 1. I have a long series, and am satisfied that they constitute one species, which is notably polymorphic. The abdomen may be either smooth or crested, either uniformly fuscous-purple or reddish on dorsum, or green with fuscous-purple or reddish spots, or with any intermediate combination. The antemedian line of forewings may be fairly broad and entire, or broken into spots or obsolete. The postmedian line may be entire or interrupted. The terminal line may be entire and broad, or interrupted, or nearly obsolete. Similar variations exist in the dark band of the hindwings. The white spot at base of the sharp tooth on hindwings is usually sharply defined clear white, but may be suffused. For the extra-Australian references I follow Sir Geo. Hampson.

N.A.: Port Darwin, 3—N.Q.: Cape York, 7; Cooktown; Port Douglas; Cairns; Geraldton; Kuranda, 2, 4, 5, 6, 7, 10; Townsville, 7; Mackay—Q.: Duaringa, Brisbane, Southport.

## Gen.30. DYSPHANIA.

*Dysphania* Hb., Verz. p.175; *Euschama* Hb., Verz. p.175; Hmps., Moths Ind. iii. p.467.

Face smooth. Tongue well developed. Palpi moderate, porrect; basal and second joints somewhat rough-haired beneath; basal joint as long as second joint; terminal joint long in both sexes. Antennæ pectinated to apex in both sexes. Thorax not crested; densely hairy beneath. Abdomen without dorsal crests; in ♂ with large terminal tuft, and lateral tufts on penultimate segment. Tibial spines short; posterior tibiæ of ♂ strongly dilated. Hindwings without costal basal expansion; frenulum and retinaculum in ♂ strongly developed; frenulum in ♀ represented by a few short hairs. Forewings with 3 and 4 separate, 6 stalked, 11 free or anastomosing with 12; a small fovea on underside above base of vein 1 in both sexes. Hindwings with 3 and 4 separate, 6 and 7 connate or separate, 8 approximated to cell near base, gradually diverging.

Type, *E. militaris* Linn., from India, China, and Java.

Although differing markedly in size and coloration, this genus does not show any striking divergence in structure from *Terpna*, but only several minor peculiarities.

## 97. DYSPHANIA FENESTRATA.

*Heliconia fenestrata* Swainson, Zool. Illust. Pl.116; *Euschama tentans* Wlk., Cat. Brit. Mus. xxxi. p.175; *Dysphania chalybeata* Butl., Ann. Mag. Nat. Hist.(4), xviii. p.127 (1876); *Dysphania magnifica* Swin., Cat. Oxf. Mus.ii. p.377.

♂♀. 76-98 mm. Head and face yellow or orange. Palpi in both sexes  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; yellow or orange; first and second joints sometimes dark purple on outer surface; terminal joint fuscous. Antennæ dark fuscous; pectinations in ♂, inner row  $2\frac{1}{2}$ , outer row 3; in ♀, inner row  $1\frac{1}{2}$ , outer row 2. Thorax dark purple, anteriorly and posteriorly broadly yellow or orange. Abdomen yellow or orange with 4 or 5 dark purple or fuscous rings. Legs dark fuscous; coxæ yellow or orange. Forewings elongate-triangular, narrower in ♂, costa gently arched, apex

rounded, termen scarcely bowed, strongly oblique; dark purple, with whitish semihyaline markings; a short broad streak from base of dorsum to mid-disc at  $\frac{1}{6}$ ; a broad fascia, interrupted by veins, from beneath  $\frac{1}{3}$  costa outwardly oblique, then curved inwards, narrowing, and suffused, to mid-dorsum; a similar fascia, usually narrower and more interrupted, from  $\frac{2}{3}$  costa to tornus; and a third similar fascia from  $\frac{1}{2}$  costa ending opposite mid-termen; cilia dark purple. Hindwings with termen gently rounded; dark purple; a whitish semihyaline blotch in cell; several similar blotches, variably developed, beyond cell; a sub-terminal series of conspicuous yellow or orange spots, the two central spots being displaced towards termen; cilia dark purple. Underside similar.

The large size and conspicuous colouring are undoubtedly aposematic. In this, the species differs from all other Australian *Geometrinae* which are protectively coloured; the *Terpna*-group imitate the bark of trees, while the colour of the majority of species is assimilated to foliage.

This species varies according to locality, forming local races. In the Cairns district is developed a dark form, the pale blotches being relatively reduced, especially in the hindwing; and the head, thorax, abdomen, and hindwings being decorated with yellow. In Torres Straits the pale blotches are larger, and yellow is replaced by orange. At Port Darwin the pale blotches are still further enlarged and confluent, the dark purple areas being reduced to a minimum, the decoration is also orange.

N.A.: Port Darwin, 9—N.Q.: Banks Island, 2; Bloomfield River; Dunk Island; Cairns; Geraldton, 11; Ingham; Townsville, 5. Also from New Guinea and Moluccas.

I have received a closely allied but distinct species from Kei Island; and other allied species occur in the Archipelago.

Gen. 31. AUTANEPHIA, n.g. [*αὐτανέψια*, a cousin.]

Head with an anteriorly directed crest on crown, face rough-haired. Tongue well developed. Palpi rather long, correct; basal and second joints densely hairy beneath; terminal joint long

in both sexes. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax not crested, beneath densely hairy. Abdomen with dorsal crests slightly indicated by some loose spreading hairs; terminal segments in ♂ with lateral tufts. Posterior tibiae with all spurs present; in ♂ not dilated. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ strong; frenulum in ♀ represented by a strong tuft of scales. Forewings with 3 and 4 remote at origin, 5 approximated at origin to 6, 6 widely separate from stalk of 7, 8, 9, 10, which arises from well before angle of cell, 11 anastomosing with 12 and 10. Hindwings with 3 and 4 widely separate, 6 and 7 separate, 8 approximated to cell as far as middle, diverging rather abruptly; dorsal discocellular strongly curved.

Type, *Hypochroma wilsoni* Feld. Distinguished from *Terpna* mainly by the peculiar neurulation of the forewing, which was noted by Mr. Meyrick.

#### 98. AUTANEPHIA WILSONI.

*Hypochroma wilsoni* Feld., Reise Nov. Pl. 125, f. 4; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 906.

Palpi in both sexes 2, terminal joint  $\frac{3}{4}$ . Antennal pectinations in ♂, inner row 3, outer row 5.

N.Q.: Stannary Hills (Dr. T. Bancroft)—Vic.: Melbourne; Gisborne, 10.

#### Gen. 32. CRYPSIPHONA.

*Crypsiphona* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 901.

Face smooth. Tongue well developed. Palpi obliquely ascending, basal and second joints with long rough hairs beneath; basal joint longer than second joint; terminal joints short in both sexes. Antennæ in ♂ pectinated, apices simple; in ♀ simple. Thorax not crested, or with a slight anterior crest; beneath densely hairy. Abdomen without dorsal crests; in ♂ with lateral tufts of hair on each segment. Posterior tibiae without middle spurs in both sexes; in ♂ sometimes dilated, with groove containing hair-tuft. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ strongly developed; frenulum in

♀ represented by a tuft of long hairs. Forewings with 3 and 4 separate, 6 separate or short-stalked, 11 anastomosing with 12 and 10. Hindwings with 3 and 4 separate, 6 and 7 separate or connate, 8 closely approximated to cell near base, rapidly diverging; discocellulars nearly straight, rather strongly oblique, costal edge of cell considerably exceeding  $\frac{2}{3}$ .

Type, *C. melanosema* Meyr. An endemic development of *Terpsia*, differing in the palpi, absence of middle spurs, and of dorsal abdominal crests.

99.†*CRYPHSIPHONA MELANOSEMA*.

*Crypsiphona melanosema* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.901.

W.A.: Albany, 9, 12.

100.†*CRYPHSIPHONA AMAURA*.

*Crypsiphona amaura* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.902.

W.A.: Albany, 9, 10.

101. *CRYPHSIPHONA OCCULTARIA*.

*Phalena occultaria* Don., Ins. N. Holl. p.36; *Hypochroma occultaria* Gn., Lep.ix. p.281; *Crypsiphona occultaria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.903.

Palpi in ♂  $1\frac{1}{2}$ , in ♀  $1\frac{1}{2}$ ; terminal joint minute in both sexes. Antennal pectinations in ♂ 3. Posterior tibiae in ♂ not dilated.

N.Q.: Townsville, Stannary Hills—Q.: Duaringa, Gayndah, Nambour; Brisbane, 2, 3, 9; Mt. Tambourine; Nanango; Dalby; Warwick, 10—N.S.W.: Newcastle; Sydney, 4; Bathurst—Vic.: Melbourne; Beaconsfield, 11; Gisborne, 2, 3—Tas.: Hobart—S.A.: Mount Lofty—W.A.: Albany; Waroona, 7.

Gen.33 *EPIPRISTIS*.

*Epipristis* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.916.

Face smooth, rounded. Tongue well developed. Palpi moderate, porrect; second joint smooth above, smooth or slightly hairy



beneath; terminal joint stout, moderate, somewhat longer in ♀. Antennæ simple in both sexes; ciliations in ♂ minute. Thorax and abdomen not crested; thorax smooth or but slightly hairy beneath. Posterior tibiae with all spurs present; in ♂ not dilated. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a tuft of long hairs. Forewings with 3 and 4 separate but closely approximated at origin, 6 separate, 11 anastomosing shortly with 12. Hindwings with 3 and 4 separate but closely approximated at origin, 6 and 7 separate, 8 closely approximated to cell at a point near base, rapidly diverging; discocellulars nearly straight, but slightly oblique. Type, *Hypochroma minimaria* Gn.

*Actenochroma* Warr., is sufficiently distinguished from this genus by the dense woolly hairiness of the underside of the thorax, and the longer approximation of vein 8 of hindwings to the cell.

#### 102. EPIPRISTIS MINIMARIA.

*Hypochroma minimaria* Gn., Lep. ix. p.279; *Hypochroma parvula* Wlk., Cat. Brit. Mus. xxi. p.435; *Acidalia truncataria* Wlk., Cat. Brit. Mus. xxiii. p.774; *Epipristis oxycyma* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.916; *Pseudoterpna minimaria* Hmps., Moths. Ind. iii. p.479.

Palpi of ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; of ♀ 2, terminal joint  $\frac{1}{2}$ . Antennal ciliations in ♂ extremely minute.

N.A.: Port Darwin, 1, 3, 10, 11—N.Q.: Cape York, 8—Q.: Duaringa. Also from Borneo, Ceylon, and India.

#### Gen.34. ACTENOCHROMA.

*Actenochroma* Warr., Proc. Zool. Soc. 1893, p.350.

Face smooth, lower edge somewhat projecting. Tongue strong. Palpi moderate, obliquely ascending; basal joint with long spreading hairs beneath, second joint smooth or slightly hairy beneath. Antennæ in ♂ slightly serrate, ciliated in tufts; in ♀ simple. Thorax not crested; beneath densely hairy. Abdomen with several median dorsal crests; terminal segments in ♂ with slight

lateral tufts. Posterior tibiae with all spurs present. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a tuft of long hairs. Forewings with 3 and 4 separate but approximated at origin, 6 separate, 11 free or anastomosing with 12 and 10. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 approximated to cell for some distance, diverging before middle.

Type, *A. turneri*. Differs from *Terpna* in the ♂ antennæ. Probably the palpi and other points vary as in that genus; and I have, therefore, refrained from drawing up the definition too rigidly on the single Australian species.

### 103. ACTENOCHROMA TURNERI.

*Hypochroma turneri* Luc., Proc. Linn. Soc. N. S. Wales, 1889, p. 1096; *Actenochroma* (?) *prasina* Warr., Nov. Zool. 1896, p. 282.

♂♀. 38-44 mm. Crown green with some whitish, and sometimes with some brownish, scales; face reddish-fuscous, upper third green, lower edge white. Palpi  $1\frac{1}{2}$ , terminal joint very short in both sexes; above reddish-fuscous, beneath whitish-ochreous. Antennæ fuscous; cillations in ♂  $\frac{3}{4}$ . Thorax green; tegulae and sometimes a posterior spot brownish-fuscous; sometimes a central whitish spot. Abdomen pale purple-fuscous and greenish, either colour preponderating; under surface whitish-ochreous. Legs whitish-ochreous; anterior coxae, femora, and tibiae suffused with purplish; anterior tarsi annulated with dark fuscous. Forewings rather elongate-triangular, costa nearly straight; apex rounded, termen strongly bowed, oblique, slightly crenulate; green with extensive areas of purplish-fuscous suffusion, extreme costal edge ochreous; a streak along costa purplish with dark fuscous strigulations; a similar basal patch, sometimes bisected; sometimes an irregular white subcostal suffusion from base to first line; first line dentate from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum, dark fuscous; second line similar, from  $\frac{3}{4}$  costa bent first outwards, then inwards to mid-dorsum; included median area suffused with purplish-fuscous towards dorsum and second line, and with a small suffused discal spot of the same colour; terminal

area extensively suffused with purplish-fuscous, leaving an apical area, and a spot on mid-termen, green; a dark fuscous terminal line interrupted on veins; cilia greenish mixed with purplish-fuscous, sometimes with a whitish spot opposite mid-termen. Hindwings with termen rounded, crenulate; as forewings but without first line and apical green patch. Underside pale purplish more or less suffused with ochreous towards base; on forewing a large dark fuscous roundish discal spot, with a whitish spot on its terminal side; on hindwing a purplish-fuscous discal dot; a whitish postmedian line, on forewings narrow and interrupted, on hindwings broad; a whitish spot on mid-termen of both wings.

A handsome but variable species. In two of my examples vein 11 is free; in the third it approaches 12 but fails to anastomose, and then anastomoses with 10. The posterior tibiae of the ♂ are not dilated in my one example.

N.Q.: Kuranda, 5, 6; Mackay. Also from Louisiades.

#### Gen.35. TERPNA.

*Terpna* H.-Sch., Ausser. Schmett.; *Hypochroma* Gn., Lep. ix. p.275; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.904 (*præocc.*).

Face smooth (rarely hairy), sometimes slightly rounded, sometimes slightly projecting at lower edge. Tongue well developed. Palpi moderate or long, porrect or ascending, basal and second joints densely hairy beneath, second joint smooth or hairy beneath; basal joint as long as second; terminal joint short or moderate, and equal or nearly so in both sexes, or much longer in ♀. Antennae in ♂ pectinated, apices simple; in ♀ simple. Thorax not crested; beneath densely hairy. Abdomen usually with small median dorsal crests, but these are sometimes obsolete; in ♂ with lateral tufts on terminal segments. Posterior tibiae with all spurs present; in ♂ sometimes dilated, with a groove and tuft of hairs on inner side. Hindwing without rounded costal expansion at base; frenulum and retinaculum in ♂ always strongly developed; frenulum in ♀ represented by a tuft of long hairs more or less

developed. Forewings with 3 and 4 separate, 5 widely separate from 6, 6 separate but closely approximate, or connate, 11 free, or anastomosing with 12, or with 12 and 10. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 approximated to cell to  $\frac{1}{2}$  or to about middle, diverging gradually or rather abruptly; discocellulars angled on vein 5 or nearly straight, slightly or moderately oblique, dorsal curved or nearly straight.

Type, *Terpna hæmataria* H.-Sch., Anser. Schmett., f 205, 206. A large genus; vein 8 of the hindwings varies in the length of its approximation to the cell and in the abruptness of its divergence, but the extremes seem to be connected by intermediates. In the palpi there are also considerable variations, but I have not seen my way to divide the genus on this ground, though on a wide survey of the whole group this might be possible. The species are coloured to imitate the bark of trees, being speckled, mottled, and often variable; they are difficult to distinguish by description. The undersides, which are much more constant, are valuable for identification.

This genus must not be identified with *Pseudoterpna* Hb., of which the type is *pruinata* Hufn. In that species there is a well marked basal costal expansion of the hindwing, and the frenulum, though fairly strong in the ♂, is obsolete in the ♀.

- |   |                  |
|---|------------------|
| 1. Forewings with antemedian line forming two strong rounded projections..... | 111. cinerea.    |
| Antemedian line of forewings without rounded projections.....                 | 2.               |
| 2. Discal spot of forewings above linear.....                                 | 3.               |
| Discal spot of forewings above, when developed, not linear.....               | 9.               |
| 3. Hindwings beneath bright orange towards base....                           | 104. miliaria.   |
| Hindwings not orange beneath.....   | 4.               |
| 4. Forewings beneath tinged with reddish.....                                 | 5.               |
| Forewings beneath not tinged with reddish.....                                | 6.               |
| 5. Wings above green-whitish with fuscous lines.....                          | 106. myricetia.  |
| Wings above brown-whitish with reddish-brown lines.....                       | 107. pereptila.  |
| 6. Wings above green.....   | 108. muscosaria. |
| Wings above whitish or grey.....  | 7.               |

- |   |                             |
|---|-----------------------------|
| 7. Wings beneath with a subterminal series of white spots in a dark band..... | 109. <i>crebata</i> .       |
| Wings beneath without subterminal white spots....                             | 8.                          |
| 8. Forewings with antemedian line straight.....                               | 106. <i>percomptaria</i> .  |
| Forewings with antemedian line strongly dentate...                            | 110. <i>chlora</i> .        |
| 9. Hindwings above pinkish-tinged.....  | 112. <i>metarhodata</i> .   |
| Hindwings above not pinkish-tinged.....                                       | 10.                         |
| 10. Wings above bright green.....   | 11.                         |
| Wings above not bright green.....   | 12.                         |
| 11. Wings beneath with subterminal band reddish.....                          | 114. <i>viridicata</i> .    |
| Wings beneath with subterminal band fuscous.....                              | 12.                         |
| 12. Wings above irrorated and strigulated with blackish                       | 115. <i>acanthina</i> .     |
| Wings above not irrorated with blackish....                                   | 116. <i>hypochromaria</i> . |
| 13. Wings beneath with crimson or reddish markings..                          | 14.                         |
| Wings beneath without crimson or reddish markings .....                       | 113. <i>deteriorata</i> .   |
| 14. Wings above with blackish crenated terminal line..                        | 117. <i>subrubescens</i> .  |
| Wings above without terminal line., .....                                     | 118. <i>quadrilinea</i> .   |

## 104. TERPNA EMILIARIA.

*Hypochroma emiliaria* Gn., Lep. ix. p.280; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.911; *Hypochroma aurantiacea* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.297; *Hypochroma subornata* Warr., Nov. Zool. 1896, p.360; *Hypochroma purpurissata* Luc., Proc. Roy. Soc. Qsld., 1901, p.77; *Hypochroma assidens* Luc., *op. cit.* p.79.

♂♀. 38-48 mm. Head whitish- or greenish-grey more or less mixed with dark fuscous, less commonly brownish-whitish; lower part of face sometimes dark fuscous. Palpi in ♂ 2½, terminal joint ½; in ♀ 3, terminal joint 1; colour as head on upper surface; lower surface whitish usually suffused with purple-reddish; whitish more or less mixed with fuscous, sometimes mostly fuscous; pectinations in ♂ 2½. Thorax whitish variably mixed with pale reddish, greenish, and dark fuscous scales. Abdomen with dorsum coloured as thorax but usually paler; sides orange-ochreous; under surface whitish-ochreous. Legs whitish-ochreous; anterior coxae reddish; middle and anterior tibiae and tarsi fuscous anteriorly, with ochreous-whitish or greenish annulations; posterior tibiae in ♂ dilated, with internal groove and tuft.

Forewings triangular, costa slightly arched, apex rounded, termen bowed, oblique, crenulate; whitish more or less irrorated and suffused with dark fuscous, pale reddish, and often with greenish; lines distinct, blackish, antemedian sometimes preceded and postmedian succeeded by a fuscous suffusion, leaving a pale median area; antemedian line slightly outwardly curved, crenulate, from  $\frac{1}{3}$  costa to  $\frac{1}{4}$  dorsum; postmedian sinuate, dentate, from  $\frac{2}{3}$  costa to slightly beyond mid-dorsum; a linear dark discal mark, outwardly oblique, beneath midcosta; a whitish, much dentate, subterminal line; a blackish terminal line, often interrupted and thickened into dots between veins; cilia whitish with pale reddish or greenish suffusion, and some dark fuscous irroration. Hindwings with termen rounded, dentate; colour and markings as forewings but without antemedian line; with tufts of raised scales before middle of disc, and on dorsum; dorsal cilia orange-ochreous. Underside of forewings with base suffused with purple-reddish; a bright orange subcostal streak reaching to middle; a triangular median white blotch including a large roundish discal spot; a broad dark fuscous terminal band including a subterminal series of white dots. Underside of forewings bright orange bordered by a median whitish transverse line; sometimes preceded by an elliptical blackish discal spot, but this is usually completely absent; a broad terminal dark fuscous band, mixed with whitish on termen; cilia whitish.

Very variable in the coloration of the upper surface, but always recognisable by the under side.

N.A.: Port Darwin, 10—N.Q.: Prince of Wales Island, 5, 6; Thursday Island; Cape York, 8; Cooktown; Cairns; Kuranda, 3, 5; Cardwell; Dunk Island; Stanuary Hills; Herberton—Q.: Gympie; Brisbane, 1. Also from New Guinea.

#### 105. TERPNA MUSCOSARIA.

*Hypochroma muscosaria* Gn., Lep. ix. p.281, Pl.vi., f.3; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.912: *Hypochroma ostraria* Feld., Reise Nov., Pl.125, f.7; *Hypochroma squamata* Feld., Reise Nov., Pl.126, f.14.

♂♀. 36-54 mm. Palpi in ♂  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{4}$ , terminal joint  $\frac{3}{4}$ . Posterior tibiæ in ♂ dilated with internal groove and tuft.

Q.: Brisbane, Stanthorpe—N.S.W.: Newcastle; Sydney, 11, 2; Mt. Kosciuszko (2,700 ft.)—Vic.: Warburton.

#### 106. TERPNA MYRIOSTICTA.

*Pseudoterpna myriosticta* Turn., Trans. Roy. Soc. S. Austr. 1904, p. 223.

Palpi in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ .

Q.: Eumundi, near Nambour, 11; Brisbane, 6.

#### 107. TERPNA PAROPTILA.

*Pseudoterpna paroptila* Turn., Trans. Roy. Soc. S. Austr. 1906, p. 130.

N.Q.: Atherton.

#### 108. TERPNA PERCOMPTARIA.

*Hypochroma percomptaria* Gn., Lep. ix. p. 280, Pl. vi., f. 4; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 907.

Palpi in both sexes  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ . Antennal pectinations in ♂ 4. Posterior tibiæ in ♂ not dilated.

N.Q.: Mt. Molloy, 12—Q.: Brisbane—N.S.W.: Newcastle—Vic.: Melbourne; Gisborne, 1, 2, 3, 4, 12—W.A.: Albany.

#### 109. TERPNA EREBATA.

*Hypochroma erebusata* Wlk., Brit. Mus. Cat. xxi. p. 443; *Hypochroma erebata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 914.

Palpi in ♂ 2, terminal joint  $\frac{1}{2}$ ; in ♀  $2\frac{1}{4}$ , terminal joint  $\frac{3}{4}$ . Antennal pectinations in ♂ 5. Posterior tibiæ in ♂ not dilated.

Q.: Duaringa; Gympie; Brisbane, 1, 2, 3, 4, 11.

#### 110. TERPNA CHLORA.

*Phalæna chlora* Cram., Pap. Exot. iv. Pl. 398, f. C: *Hypochroma crenaria* Gn., Lep. ix. p. 278; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p. 915; *Hypochroma lariataria* Wlk., Cat. Brit. Mus. xxi. p. 455;

*Hypochroma distenta* Wlk., Cat. Brit. Mus. xxi. p.434; *Boarmia leucostigmata* Nietn., Edinb. New Phil. Journ. 1862, p.387; *Hypochroma irrorataria* Moore, Proc. Zool. Soc. 1867, p.632; *Hypochroma sublimbata* Butl., Ann. Mag. Nat. Hist.(5)x. p.232; *Hypochroma paulinaria* Pag., Jahrb. Nass. Ver. 1885, p.47, Pl.i. f.1; *Pingasa candidaria* Warr., Nov. Zool. 1894, p.382; *Pseudoterpna chlora* Hmps., Moths Ind. iii. p.473.

Palpi long, ascending; in ♂ 2, terminal joint 1; in ♀ 3; terminal joint  $1\frac{1}{2}$ . Antennal pectinations in ♂ 2. Posterior tibiæ in ♂ dilated, with internal groove and tuft. Hindwings with 8 approximated to cell to  $\frac{1}{2}$ , then abruptly diverging. The elevated tufts of scales on the hindwings of this and some other species are of specific value only.

N.Q.: Cairns, Atherton, Stannary Hills; Townsville, 4; Dunk Island—Q.: Rockhampton; Nambour; Brisbane, 2, 5; Stradbroke Island. Also from the Malay Archipelago, Ceylon, and India.

#### 111. TERPNA CINEREA.

*Pingasa cinerea* Warr., Nov. Zool. 1894, p.382; *Hypochroma singularis* Kershaw, Vict. Naturalist, 1897, p.104; *Skorpisthes unda-scripta* Luc., Proc. Roy. Soc. Qld. 1899, p.143.

♂, 42 mm. Head ochreous-whitish. Palpi  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; ochreous-whitish; outer aspect of second joint pale fuscous. Antennæ ochreous-whitish. Thorax ochreous-whitish. Abdomen ochreous-whitish, crests pale reddish-brown. Legs ochreous-whitish. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique, crenulate; ochreous-whitish; costa strigulated with pale grey; a dark fuscous line from  $\frac{1}{4}$  costa, forming two rounded projections outwardly in disc, then strongly inwardly oblique to  $\frac{1}{4}$  dorsum; an oval dark fuscous discal ring before middle; a fine postmedian dark fuscous line from  $\frac{3}{4}$  costa, at first transverse, then strongly inwardly oblique to mid-dorsum, with numerous very acute dentations, placed closely in transverse part, widely separate in oblique part; this line is followed by two fuscous blotches, one above middle, the other above tornus; a fine dark fuscous terminal line; cilia ochreous-whitish. Hindwings



elongate, termen strongly bowed, strongly dentate; vein 8 closely approximated to cell to  $\frac{1}{4}$ , abruptly diverging; colour as forewings; a ridge of raised scales before middle of disc; no ante-median line nor discal dot; postmedian line and blotches as forewings; terminal area suffused with pale grey. Underside whitish; forewings with oval fuscous discal spot; both wings with fuscous terminal bands, in forewings especially broad at apex, in hindwings narrow at apex.

Q. 48 mm. Palpi 2, terminal joint  $\frac{3}{4}$ . Wings finely irrorated with pale grey; lines mixed with pale reddish scales; discal mark of forewings inconspicuous and linear; postmedian blotches pale reddish.

Q.: Wynnum, near Brisbane—Vic.: Narracan, 2.

This species is remarkable for its attitude during rest. The forewings are directed directly forwards, the costæ being parallel, while the hindwings are directed backwards, their dorsal edges being appressed to the abdomen. It appears to be very retired in its habits, and very hard to distinguish on the bark of the stems of *Melaleuca*.

### 112. TERPNA METARHODATA.

*Scotosia metarhodata* Wlk., Cat. Brit. Mus. xxvi. p.1724; *Hypochroma metarhodata* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.908.

Palpi  $1\frac{1}{2}$ , terminal joint short in both sexes. Antennal pectinations in ♂  $2\frac{1}{4}$ . Posterior tibiae in ♂ not dilated.

Q.: Brisbane—N.S.W.: Newcastle, 9; Sydney, 3, 4, 9—Vic.: Sale, 1.

### 113. TERPNA DETERIORATA.

*Hypochroma deteriorata* Wlk., Cat. Brit. Mus. xxi. p.441; Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.913; *Hypochroma nigraria* Feld., Reiss Nov. Pl. 126, f.1.

Palpi in ♂  $1\frac{1}{2}$ ; terminal joint  $\frac{1}{4}$ . Antennal pectinations in ♂ 4. Posterior tibiae in ♂ slightly dilated.

N.S.W.: Sydney, 4, 10.

## 114. TERPNA VIRIDICATA.

*Hypochroma viridicata* Luc., Proc. Linn. Soc. N. S. Wales, 1889, p.1094.

♂. 44 mm. Palpi 2, terminal joint  $\frac{1}{2}$ . Antennal pectinations 3. Forewings triangular, costa straight, apex rounded, termen bowed, oblique; mossy green, markings blackish-fuscous; an interrupted wavy line from midcosta to  $\frac{2}{3}$  dorsum; an ill-defined discal spot beyond this line; an interrupted dentate line from  $\frac{2}{3}$  costa to  $\frac{2}{3}$  dorsum, containing two conspicuously dark teeth about middle. Hindwings with termen rounded; colour and markings as forewings. Underside pale ochreous; a dark fuscous oval discal spot on forewings; a linear reddish discal mark on hindwings; a broad reddish subterminal band on both wings, containing in forewings a suffused fuscous spot above middle.

Q.: Brisbane, Buderim Mountain, near Nambour; in December, one specimen in the Queensland Museum, in poor condition; taken by Mr. C. J. Wild.

## 115. TERPNA HYPOCHROMARIA.

*Clara(?) hypochromaria* Gn., Lep. ix. p.234; *Hypochroma hypochromaria* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.909; *Pseudoterpna bryophanes* Turn., Trans. Roy. Soc. S. Austr., 1904, p.222.

Palpi in both sexes 2, terminal joint  $\frac{1}{2}$ . Antennal pectinations in ♂ 3. Posterior tibiae of ♂ dilated, with internal groove and tuft.

N.Q.: Cape York, 4—Q.: Brisbane, 5, 8, 9, 11—N. S. Wales. —.

## 116. TERPNA ACANTHINA.

*Hypochroma acanthina* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.910.

Palpi in ♂  $1\frac{1}{2}$ , terminal joint minute. Antennal pectinations in ♂ 3. Posterior tibiae in ♂ not dilated.

Q.: Duaringa.

## 117. TERPNA SUBRUBESCENS.

*Hypochroma subrubescens* Warr., Nov. Zool. 1896, p.101.

♂. 30 mm. Head white, face with a dark green transverse line below middle. Palpi in ♂  $1\frac{1}{2}$ , terminal joint short; fuscous, extreme base and apex whitish. Antennæ whitish, towards apex grey; pectinations in ♂ 2. Thorax white mixed with dark green. Abdomen white; tuft and underside ochreous-whitish. Legs ochreous-whitish; anterior pair dark fuscous annulated with whitish; posterior tibiae in ♂ not dilated. Forewings triangular, costa nearly straight, apex rounded, termen bowed, oblique; white, faintly pinkish-tinged, with dark green irroration in places; costa with minute dark green strigulations; lines dark green mixed with blackish; a transverse line at base not reaching costa; a strongly dentate line at  $\frac{1}{2}$ ; a short line from midcosta to a somewhat triangular white-centred discal spot; postmedian finely dentate, outwardly curved from  $\frac{2}{3}$  costa, lost in disc; subterminal with blackish dentations, sinuate, edged posteriorly by a fine white line; a crenulate blackish terminal line, touching termen on veins; cilia white, with some greenish and pinkish suffusions, interrupted by blackish bars opposite veins. Hindwings with termen rounded; colour as forewings but without basal and ante-median lines and discal dot. Underside whitish-ochreous; forewings with a blackish discal spot and a broad crimson streak above dorsum; both wings with fine postmedian lines and broad sub-terminal bands, partly crimson, partly blackish-fuscous.

N.Q.: Townsville, 4; Mackay (type).

## 118. TERPNA QUADRILINEA.

*Hypochroma quadrilinea* Luc., Proc. Roy. Soc. Qsld. 1891, p.80;

*Actenochroma ochrea* Warr., Nov. Zool. 1896, p.360.

♂♀. 32-44 mm. Head whitish; face whitish with some reddish and dark fuscous scales, rarely mostly dark fuscous. Palpi in both sexes  $2\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; fuscous, apex and undersurface whitish. Antennæ whitish; pectinations in ♂ 2. Thorax and abdomen whitish. Legs whitish; anterior pair suffused with pale fuscous leaving whitish annulations; posterior tibiae in ♂ not

dilated. Forewings triangular, costa nearly straight, apex rounded, termen bowed, oblique, slightly crenulate; whitish, markings fuscous or fuscous-brown; a series of dots on costa, those marking commencement of lines being larger; antemedian line from  $\frac{1}{3}$  costa to  $\frac{1}{3}$  dorsum, often obsolete except at extremities; a suffused fuscous median discal spot containing a whitish central dot; postmedian from  $\frac{1}{3}$  costa to  $\frac{1}{3}$  dorsum, fine, dentate, sometimes partly obsolete; sometimes a blotch on dorsum following antemedian; a suffused irregular blotch between postmedian and termen; besides these markings, a variable amount of irroration sometimes forming strigulae; cilia whitish. Hindwings with termen rounded, crenulate; colour, irroration and cilia as forewings; no antemedian line; discal dot minute or absent; postmedian curved, finely dentate. Underside ochreous-whitish; markings dark reddish or dark fuscous, one or the other shade preponderating; both wings with discal spots, larger on forewings, fine postmedian lines, and broad subterminal bands; forewings with a broad longitudinal streak above and parallel to dorsum.

A variable species. My examples are mostly undated, but I suspect there are two seasonal forms, a larger paler summer form with markings on underside mostly reddish, and a smaller darker winter form with markings on underside mostly fuscous.

N.Q.: Kuranda, 3; Mackay—Q.: Brisbane, 12—N.S.W.: Byron Bay, 1.

#### Gen. 36. OENOCHLORA.

*Oenochlora* Warr., Nov. Zool. 1896, p. 353.

Face smooth. Tongue well developed. Palpi stout, rather long, obliquely ascending; second joint smooth, or only slightly roughened beneath; terminal joint stout and rather short in both sexes. Antennae in ♂ pectinated nearly to apex; in ♀ serrate. Thorax and abdomen not crested; thorax hairy beneath; abdomen in ♂ with slight lateral tufts on terminal segments. Posterior tibiae with all spurs present; in ♂ strongly dilated, with internal groove and tuft. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a tuft of long hairs. Forewings

with 3 and 4 separate, 6 separate, 11 anastomosing strongly with 12 and 10, sometimes the anastomosis with 12 is replaced by a short connecting bar. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 closely approximated to cell from near base to beyond middle; discocellulars not angled, but rather strongly inwardly curved, only slightly oblique.

Type, *Oenochlora imperialis* Warr. The true position of this genus is not open to doubt. The only important character in which it differs from *Terpna* is the longer approximation of vein 8 of hindwings to the cell, a primitive trait in which it agrees with *Rhuma* and *Helimystis*.

#### 119. OENOCHLORA IMPERIALIS.

*Oenochlora imperialis* Warr., Nov. Zool. 1896, p.354; *Euaerestus nobilitans* Luc., Proc. Roy. Soc. Qld. 1899, p.142; *Euaerestus patrocinatus* Luc., Proc. Roy. Soc. Qld. 1899, p.142.

♂♀. 40-44 mm. Head and face bright green. Palpi 2, terminal joint  $\frac{1}{2}$ ; purple, extreme apices of joints and basal part of underside ochreous-whitish. Antennæ whitish, towards base purple; pectinations in ♂ 3. Thorax bright green. Abdomen green; usually with a brownish or brownish-fusca band before middle; apex and undersurface whitish-ochreous. Legs whitish-ochreous; anterior femora suffused in front with fuscous-purple; middle and anterior tibiae and tarsi annulated with fuscous. Forewings triangular, costa rather strongly arched towards base, apex acute and slightly produced, termen straight, rounded towards torus; bright green; markings very variable; costal edge purplish dotted with fuscous; antemedian line obsolete or very faintly indicated; postmedian line darker green, slender, straight, from  $\frac{1}{2}$  costa to  $\frac{1}{2}$  dorsum, sometimes with minute purplish dots on veins, the whole line often obsolete; sometimes one or two whitish-ochreous spots outlined with reddish-purple, immediately following middle of postmedian line; sometimes a large purplish toral blotch; cilia green. Hindwings with termen but slightly bowed, toral angle prominent; colour as forewings; costa suffused with pale purplish; sometimes a dark green median transverse line; sometimes

irregular patches of purplish suffusion in dorsal area beyond this line. Underside pale orange-ochreous; a discal dot, and a broad irregular subterminal band on both wings purple; terminal area greenish.

N.Q : Cooktown, Cairns; Kuranda, 3, 4, 5, 11, 12—Q. : Brisbane: Mount Tambourine, 2.

### Gen. 27. STERICTOPSIS.

*Sterictopsis* Warr., Nov. Zool. 1898, p. 257.

Face smooth or shortly rough-haired. Tongue well developed. Palpi moderate, ascending, basal and second joints densely rough-haired beneath, second joint rough-haired on uppersurface, terminal joint short in both sexes. Antennæ in ♂ pectinated, apices simple. Thorax with a short but dense posterior crest; beneath densely hairy. Abdomen with four large dense median dorsal crests. Posterior tibiae with all spurs present; in ♂ dilated, with internal groove and tuft. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ strongly developed. Forewings with 3 and 4 separate, 6 separate or stalked, 10 arising separately from cell, 11 free, or anastomosing with 12, or with 12 and 10. Hindwing with 3 and 4 well separated at base, 6 and 7 short-stalked, 8 closely approximated to cell as far as middle, then diverging; discocellulars not angled, only moderately oblique, dorsal curved.

Type, *Hypochroma paratorna* Meyr. In the separate origin of vein 10 and the thoracic crest this agrees with *Heliomysis*. The main point of distinction is the stalking of 6 and 7 of the hindwings. The shorter approximation of vein 8 to cell is an additional point. I have examined the structural characters of the type of *Sterictopsis inconsequens* Warr.

### 120. STERICTOPSIS PARATORNA.

*Hypochroma paratorna* Mayr., Proc. Linn. Soc. N. S. Wales, 1887, p. 906; *Pseudolerna argyrae* Low., Trans. Roy. Soc. S. Austr., 1893, p. 157; *Sterictopsis inconsequens* Warr., Nov. Zool., 1898, p. 257.

Antennal pectinations in ♂ 3. Palpi 1½. Though easily recognised by the structural characters, this seems to be a very variable species. I have two examples before me, both males, and both from Gisborne. The first corresponds generally to Mr. Meyrick's description, but differs in details; the first line is obsolete on one side, on the other very slender and dentate, the discal spot pale-centred, the second line is reduced to streaks on veins, there is a dentate subterminal line in costal area only, and the terminal line is obsolete. The second example is melanic, the greater part of the forewings is suffused with dark fuscous, and the whole of the hindwings is dark fuscous except for a very slight imperfect subterminal line. The two examples are certainly conspecific.

Q.: Duaringa, 10—Vic.: Gisborne, 11, 12—S. Austr.: Mount Lofty.

Gen. 38. RHUMA.

*Rhuma* Wlk., Cat. Brit. Mus. xxi. p. 483.

Face smooth. Tongue well developed. Palpi moderate, porrect or obliquely ascending; basal joint with long spreading hairs; second joint smooth; terminal joint short in both sexes. Antennæ in ♂ slightly serrate, ciliated; in ♀ simple. Thorax with a small posterior crest; beneath densely hairy. Abdomen with strong median dorsal crests. Posterior tibiæ with all spurs present; in ♂ strongly dilated, with internal groove and tuft, middle spurs long, terminal spurs abbreviated, and with a short stout terminal process. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ well developed; frenulum in ♀ represented by a tuft of long hairs. Forewings with 3 and 4 separate, 6 separate, 10 arising separately from cell, 11 free. Hindwings with 3 and 4 widely separate, 6 and 7 separate, 8 closely approximated to cell to well beyond middle; discocellulars not angled, moderately oblique, dorsal curved.

Type, *Rhuma subaurata* Wlk. Closely allied to *Helicomystis*. The thoracic crest is less marked, and the ♂ antennæ not pectinated.

## 121. RHUMA SUBAURATA.

*Rhuma subaurata* Wlk., Cat. Brit. Mus. xxi. p.484.

♂♀. 32-40 mm. Crown fuscous-grey; face whitish or whitish-ochreous with two fuscous dots below middle. Palpi in ♂  $1\frac{1}{2}$ , terminal joint very short; in ♀  $1\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; fuscous, apex whitish. Antennæ fuscous, inner surface towards base whitish; ciliations in ♂ 1. Thorax fuscous-grey; apices of tegulæ and bases of patagia white. Abdomen fuscous-grey; beneath pale ochreous. Legs fuscous; anterior tibiæ and tarsi annulated with white; posterior pair whitish-ochreous. Forewings triangular, costa gently arched, apex rounded, termen bowed, oblique; fuscous-grey; median area white; markings dark fuscous; a quadrangular spot beneath costa near base; three similar costal spots in white area; antemedian line at  $\frac{1}{2}$ , represented by a curved series of three or four large dots; an oval white-centered discal spot beneath midcosta; postmedian line represented by a series of large dots on veins, from  $\frac{2}{3}$  costa, angled in disc, thence sinuate to mid-dorsum in ♂, to  $\frac{2}{3}$  dorsum in ♀; a fine interrupted crenulate subterminal line, preceded by a darker shade; veins in outer part of disc suffused with ochreous; an interrupted terminal line; cilia fuscous-grey, obscurely barred with whitish. Hindwings with termen rounded; colour and markings as forewings, but without first line, median area not white, dorsal cilia usually ochreous. Underside deep ochreous with dark fuscous circular discal spots and broad subterminal bands on both wings.

Q.: Brisbane 11.

## Gen. 39. HELIOMYSTIS.

*Heliomystis* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.900.

Face shortly hairy. Tongue well developed. Palpi moderate, porrect, basal and second joints densely hairy beneath, second joint hairy on upper surface, terminal joint moderate. Antennæ in ♂ pectinated nearly to apex. Thorax with a dense posterior crest; beneath densely hairy. Abdomen with strong median dorsal crests. Posterior tibiæ with all spurs present; in ♂ dilated,



with internal groove and tuft. Hindwings without basal costal expansion; frenulum and retinaculum in ♂ strong. Forewings with 3 and 4 separate, 6 connate, 10 arising separately from cell, 11 anastomosing with 12. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 approximated to cell beyond middle; discocellulars angled on vein 5, dorsal strongly angled towards base beneath vein 5, then rather strongly oblique.

Type, *H. electrica* Meyr.

#### 122. HELIOMYSTIS ELECTRICA.

*Heliomytis electrica* Meyr., Proc. Linn. Soc. N. S. Wales, 1887, p.900.

Antennal pectinations 4. Palpi in ♂ 2, terminal joint  $\frac{1}{2}$ .

Vic.: Gisborne, 12.

#### Gen. 40. PROTOPHYTA, n.g. [*πρωτοφυτες*, first-born.]

Face smooth. Tongue well developed. Palpi moderate, obliquely ascending; basal joint with long spreading hairs; second joint rough-haired above and beneath; terminal joint moderate. Antennae in ♂ pectinated, apices simple. Thorax and abdomen not crested; thorax densely hairy beneath. Posterior legs of ♂ [unknown]. Hindwings without costal expansion at base; frenulum and retinaculum in ♂ well developed. Forewings with 3 and 4 separate, 6 separate, 10 arising separately from cell, 11 anastomosing with 12. Hindwings with 3 and 4 separate, 6 and 7 separate, 8 closely approximated to cell to well beyond middle; discocellulars incurved, not oblique.

Type, *Pseudoterpna castanea* Low. I regard this as the most primitive genus so far known, and as almost in the direct line of ancestry of *Terpna*.

#### 123. PROTOPHYTA CASTANEA.

*Pseudoterpna castanea* Low., Proc. Linn. Soc. N. S. Wales, 1898, p.45.

♂. 39 mm. Head ochreous-whitish. Palpi in ♂ 1 $\frac{1}{2}$ , terminal joint  $\frac{1}{2}$ ; ochreous-whitish. Antennae ochreous-whitish; pecti-

nations in ♂ 3. Thorax ochreous-whitish, anteriorly suffused with reddish-brown. Abdomen ochreous-whitish. Legs fuscous annulated with whitish; [posterior pair broken]. Forewings rather elongate-triangular, costa slightly arched, apex rounded, termen bowed, oblique, crenulate; ochreous-whitish, markings reddish-brown; a suffused subcostal streak bisected by a whitish line near base; a wavy line from  $\frac{1}{2}$  costa to  $\frac{1}{4}$  dorsum, darker towards dorsum; a similar line from mid-costa to  $\frac{2}{3}$  dorsum, followed by a dark fuscous mark on dorsum; an interrupted subterminal line; an interrupted terminal line, obsolete towards apex; cilia ochreous-whitish. Hindwings with termen dentate, teeth on veins 4 and 6 more prominent; colour and cilia as forewings; a suffused antemedian brown band obsolete towards costa; a double brown subterminal line. Underside ochreous-whitish, with reddish-brown subapical circular blotches on both wings.

Type(redescribed) in Coll. Lyell.

N.S.W.: Liverpool near Sydney; one specimen on tea-tree bark, in January.

*Species unrecognised or wrongly referred.*

124. *Hypochroma velutinata* Wlk., Cat. Brit. Mus. xxi. p.442, is a synonym of *Gastrina cristaria* Gn.(*Boarmiana*).

125. *Hypochroma dissentanea* Wlk., Cat. Brit. Mus. xxi. p.442, and

126. *Hypochroma dissonata* Wlk., Cat. Brit. Mus. xxi. p.443, are both synonyms of *Ectropis fractaria* Gn.(*Boarmiana*).

127. *Hypochroma nyssiata* Feld., Reise Nov. Pl.125, f.3, is probably a species of *Hypographa* (*Monocistiana*).

128. *Iedis glaucescens* Luc., Proc. Linn. Soc. N. S. Wales, 1888, p.1263, belongs to the genus *Asthena* (*Larentiana*).

129. *Hypochroma maculata* Luc., Proc. Linn. Soc. N. S. Wales, 1869, p.1095, from Mackay.

130. *Iedis barnarda* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.263, from Dnaringa.

131. *Iodis multistincta* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.295, from Brisbane.

132. *Hypochroma diffundens* Luc., Proc. Linn. Soc. N. S. Wales, 1891, p.298, from Duaringa.

133. *Iodis nitida* Luc., Proc. Linn. Soc. N. S. Wales, 1892, p.252, from Eumundi, near Nambour, Q.

134. *Iodis ipomopsis* Low., Trans. Roy. Soc. S. Austr. 1892, p.14, from Balhannah and Belair, S.A.

135. *Hypochroma eugramma* Low., Trans. Roy. Soc. S. Austr., 1892, p.14, from Adelaide.

136. *Euchloris microgyna* Low., Trans. Roy. Soc. S. Austr. 1894, p.85, is a synonym of *Asthenes glauca* Luc. (*Larentianæ*).

137. *Eucrostes nanula* Warr., Nov. Zool. 1897, p.211. The type is much worn and so imperfect as to be unrecognisable.

138. *Hypochroma conspurcata* Luc., Proc. Roy. Soc. Qld. 1898, p.68, from Brisbane.

139. *Hypochroma munita* Luc., Proc. Roy. Soc. Qld. 1901, p.78, from Cairns.

140. *Euchloris pisochroa* Turn., Trans. Roy. Soc. S. Austr. 1906, p.128, belongs to the genus *Aplochloa* (*Boarmianæ*).

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<i>iodioides</i> Luc.	96	<i>oxycyma</i> Meyr....	..
<i>iosoma</i> Meyr.	67	<i>paratorna</i> Meyr.	..
<i>ioctiota</i> Meyr.	60	<i>paroptila</i> Turn....	..
<i>ipomopsis</i> Low.	134	<i>partita</i> Wlk. ...	..
<i>irrorataria</i> Moore	110	<i>parvula</i> Wlk. ...	..
<i>isadelpha</i> , n.sp....	23	<i>patrocinatus</i> Luc.	..
<i>lacunaria</i> v. Hed.	96	<i>paulinaria</i> Pag.	..
<i>laesaria</i> Wlk.	2	<i>pellucidula</i> Turn.	..
<i>laetata</i> Fabr.	96	<i>penicillata</i> Wlk.	..
<i>lariaria</i> Wlk.	110	<i>percomiptaria</i> Gn.	..
<i>latilineata</i> Wlk.	15	<i>periphraeta</i> Turn.	..
<i>leucochorda</i> Meyr.	24	<i>perlepidaria</i> Wlk.	..
<i>leucomerata</i> Wlk.	4	<i>perlineata</i> Warr.	..
<i>leucospilota</i> Turn.	1	<i>phaeostigma</i> , n.sp.	..
<i>leucostigmata</i> Nietn.	110	<i>pictifimbria</i> Warr.	..
<i>maculata</i> Moore	2	<i>pieroides</i> Wlk. ...	..
<i>maculata</i> Luc. ...	129	<i>pisina</i> Warr. ...	..
<i>magnifica</i> Swin.	97	<i>pisochroa</i> Turn.	..
<i>margarita</i> Warr.	12	<i>prasina</i> Swin. ...	..
<i>marginata</i> Luc.	8	<i>prasina</i> Warr. ...	..
<i>maris</i> Luc. ...	49	<i>prasinaspis</i> Meyr.	..
<i>marinaria</i> Gn. ...	47	<i>purpuriseta</i> Luc.	..
<i>meandrararia</i> Gn.	21	<i>pyropa</i> Meyr. ...	..
<i>megaloptera</i> Low.	77	<i>pyrrhogona</i> Wlk.	..
<i>melanosema</i> Meyr.	99	<i>quadraria</i> Gn. ...	..

	No.		No.
quadrilinea Luc.	118	sublimbata Butl.	110
quantilla, n.sp. ...	14	submissaria Wlk.	82
quieta Luc. ...	13	subornata Warr.	104
quinaria Moore...	96	subrubescens Warr.	117
rhodocosma Meyr.	54	tachypora, n.sp.	45
rhodocrossa Turn.	30	tanygona Turn.	46
rhodoloma, n.sp.	31	tentans Wlk.	97
rhytiphorus Low.	52	tetralopha Low.	70
rufonigraria Wlk.	79	tetraspila Low...	41
saturataria Wlk.	93	thalassica Turn.	66
scitissimaria Wlk.	82	truncataria Wlk.	102
semicrocea Wlk.	59	turneri Luc.	108
semihyalina Wlk.	51	unda-scripta Luc.	111
sideralis Luc. ...	86	undilinea Warr.	91
singularis Kershaw	111	velutinaria Wlk.	124
sinuata Moore ...	50	venusta Warr. ...	72
smaragdus Hmps.	48	veraria Gn.	62
speciosa Luc.	86	vertumnaria Gn.	32
squamata Feld.	105	viridicasta Luc.	114
steroota Meyr.	43	vulnerata Butl.	29
subalbida Warr.	77	wilsoni Feld.	98
subalpina Luc.	59	wuka Pag.	67
subaurata Wlk...	121	zuthocrania Turn.	

POSTSCRIPT (added 2nd November, 1910).—Mr. L. B. Prout informs me, in a letter received as this is going through the press, that there is a specimen of "*Nemoria*" *pisina* Warr., in the British Museum, from North-West Australia; and that it is a male, with two pairs of spurs on the posterior tibiae; also that there is another example from Port Moresby, which answers to the description of *Iodis neomela* Meyr. The synonymy will therefore stand as follows:—

#### METALLOCHLORA NEOMELA.

*Iodis neomela* Meyr., Trans. Ent. Soc. 1889, p.492; *Nemoria pisina* Warr., Nov. Zool. 1899, p.26.

N.A.: Port Darwin—N.W.A. Roebuck Bay Also from New Guinea and Tenimber Islands.

The reference for *Comostola versidaria* Snel., is Tijds. v. Ent. 1881, p.76, Pl. 10, f. 10, 11. Mr. Meyrick has recorded this species from New Guinea.

Corrigendum.—In the Table, on p. 550, for 32 *CRYSPHONA*, read 32 *CERYSPHONA*. The break in the main line to allow for the insertion of this name, is accidental, and therefore without significance.

# DESCRIPTION OF A FOSSIL LORICA FROM NORTH-WESTERN TASMANIA.

BY A. F. BASSET HULL.

[ MOLLUSCA: *Polyplacophora* ]

(Plate xvii., figs. 1-2.)

LORICA DUNIANA, n.sp.

One example of median valve.

Shell elevated, carinated, deeply decussated throughout. Lateral areas: strongly raised, ornamented with four, increasing at the sutural edge to seven, radial rows of large flattened pustules. A well defined row of ocelli follows the front ridge of the area. Central area: longitudinally ribbed with about 25 strong nodulose ridges, with broad interspaces gradually increasing in width towards the insertion-plates, and diminishing in height over the jugal tract. Dimensions: width 25 mm.

Insertion-plates are missing, but there is an indication of one slit.

Remarks.—This species is allied to *L. affinis* Ashby and Torr,\* but is distinguishable from that species by the wider interspaces in the central area, and the larger pustules and number of rows on the lateral areas. It is also allied to the living species, *L. volvox* Reeve, (New South Wales, South Australia, etc.) but differs from that species in the number of ribs on the central area, and the distribution of pustules.

This fossil Obolon was collected by Mr. W. S. Dun, from the base of the Turritella Sandstone, at the foot of a bluff between

\* Ashby, E., and Torr, W. G., "Fossil Polyplacophora from Eocene Beds of Muddy Creek, Mornington (Schnapper Point) and Moorabool, Victoria. Trans. Roy. Soc. of South Australia, 1901, p. 137, pl. iv., fig. 7.

Wynyard and Table Cape, North-west coast of Tasmania. Mr. Dun adds: "These beds are referred by Hall and Pritchard to the Jan-Jukian, that is to say they are near the base of the Tertiary as developed in Southern Australia. Victorian geologists correlate them with the marine series at Spring Creek. The Eocene age attributed to these beds must be regarded as purely relative."

I have much pleasure in associating this species with the discoverer. Type in the Australian Museum.

#### EXPLANATION OF PLATE XVII., FIGS. 1-2.

Fig.1.—*Lorica duniana*: one-half valve (median); insertion plate "restored."

Fig.2.—*Lorica volvox* Reeve: corresponding one-half valve for comparison.

Both much magnified.



**WEDNESDAY, SEPTEMBER 27TH, 1910.**

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, September 28th, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

Mr. HARRY BURRELL, Manilla, N.S.W.; Mrs. HARRY BURRELL, Manilla, N.S.W.; Mr. EDWARD GRIFFITHS, B.Sc., University of Sydney; Miss ANNIE ROSINA ROTHWELL, Lismore, N.S.W.; and Mr. HENRY L. WHITE, Belltrees, Scone, N.S.W., were elected Ordinary Members of the Society.

The President made regretful reference to the death of Mr. William Forsyth, B.A., a Member of the Society, who was present at the last Meeting, apparently in excellent health; and whose demise took place unexpectedly and somewhat suddenly on September 14th. A number of Members bore testimony to Mr. Forsyth's merits, personal and scientific; and, on the motion of Mr. R. T. Baker, it was resolved that an expression of regret, and of sincere sympathy with the members of the family, should be tendered to Mrs. Forsyth.

The Donations and Exchanges received since the previous Monthly Meeting (August 31st, 1910), amounting to 10 Vols., 58 Parts or Nos., 36 Bulletins, 1 Report and 17 Pamphlets, received from 41 Societies, &c., and one Individual, were laid upon the table.

## NOTES AND EXHIBITS.

Mr. Froggatt exhibited (1) specimens of the Shade-midge (*Bibio imitator*) with a note on its life-history. Mrs. Lister Lister found parts of her garden at Mosman swarming with elongate brown maggots having each segment fringed with a coarse bristle-like appendage. The larvæ pupated in the damp soil, and the flies emerged on the 25th September, 1910. (2) A collection of ants containing the cotypes of a number of new species recently described by Dr. Forel, from the Solomon Islands, and Tennant's Creek, Central Australia, collected by Mr. Field, with observations on some of the cosmopolitan species.

Mr. D. G. Stead exhibited a series of specimens\* of the Estuary Perch, *Perca latipes colonorum* (Günther), and the Freshwater Perch, *P. fluviatilis* Stead, to illustrate the distinctiveness of the two species; and he contributed the following Note:—"At the July Meeting of this Society, Mr. A. R. McCulloch read a Note upon the identity of the Freshwater Perch, and stated that, from an examination of a series, including intermediate forms, he believed it to be, in reality, an extreme variation of *P. colonorum*; and that it appeared to be represented by Steindachner's figure of *Dulus novemaculeatus*. With the latter part I need not deal here, as it is merely a question of synonymy, and has no bearing upon the actual question of the specific identity of the two Eastern Perches. Mr. McCulloch intends to convey to us, as Ogilby did in 1893, upon an examination of the same material (apparently with the exception of one specimen), that the two forms distinguished by me, and by my Department, as "Freshwater" Perch and "Estuary" Perch respectively, are specifically the same. Now the conclusions come to by me in 1905, and upon which the separation of the two species was founded, were only arrived at after the examination of a great many specimens

\* Both kinds preserved in formalin.

from various localities, and no "*intermediate forms*" were ever found. Since that time, thousands of these fishes have come under my observation, and many hundreds of each species have passed through my hands; and never at any time was there a moment's hesitation as to the species to which any individual belonged, either on my part, or on the part of assistants. I specially mention this, as the differences between the two forms, to which I shortly drew attention in these Proceedings in 1906 (pp.261-262), and which are now still further insisted on as absolutely constant, are not of such a nature as to require the judgment of the expert, as they are apparent to every fisherman and angler. I have observed and examined these two species of fishes from the Gippsland Lakes to the Tweed River; and in all cases the leading features of difference were the same, and the two kinds easily separable. In addition, I may mention that, in an official capacity, some hundreds of living examples of the Freshwater Perch have come under my notice, as they have been kept in ponds under observation; but in no case has the Estuary Perch been kept (the latter in view of my discovery as to the localities of spawning). In many waters the fishermen have distinctive names for the two kinds. For instance, in the Gippsland Lakes they call the Estuary Perch "Perch," and the Freshwater Perch "Leather jacket" Perch. The latter, it may be mentioned, is the real "Gippsland" Perch, which has achieved great fame in Victoria for its sporting qualities. Much more might be written here regarding this question, but I think the differences, as set out in the following paragraphs, will serve my purpose best:—

**FRESHWATER PERCH** (*Percalates fluviatilis*).—General form somewhat elliptical and elongate. Body somewhat compressed. Local habitat: from the limits of the freshwater down to the brackish water (and occasionally in flood-time penetrating to the saltwater bays and estuaries). Spawning time: about September and October (or still later). Spawns in the freshwater of the eastern rivers and creeks. Egg adhesive and demersal. Grows exceptionally to a weight of 6 lbs. The "Black Bass" of Aus-

tralia, much sought after by anglers. Takes the fly and the "spinner" well, and is a great fighter. Usually caught by line, near the surface.

**ESTUARY PERCH** (*Percalates colonorum*).—Back more gibbous and short, and with an excavate snout. Body highly compressed. Local habitat: from the ocean entrances to bays and estuaries, up to the limits of brackish water, and occasionally beyond. Spawning time: about June and July. Spawns in the bays and estuaries. Egg separate and pelagic. Grows exceptionally to a weight of 4 lbs. Not much sought after by anglers. Very rarely takes any artificial bait at all, and has never yet been known to take the "spinner." Usually caught by line, near the bottom.

Much more might be written to show the differences existing between these two species of *Percalates*, but sufficient has been put forward to justify what has been previously written by me on the same subject. Good photographic illustrations of typical examples of the two species will be found on Plate xxii. of my "Edible Fishes of New South Wales" (1908). In conclusion, I may mention that a considerable amount of material bearing on this question has been, and is being, worked up, and will be published later on.

Mr. Stead also exhibited a water-beetle, *Eretes australis*, which he had found, in great abundance, in the Dry Bogan, at Mooculta, near Bourke.

Mr. T. H. Johnston exhibited a series of Entozoa comprising—(1) *Strongylus rubidus* Hass. and Stiles, from the mucosa of a pig's stomach (Sydney); (2) *Trichostrongylus instabilis* Raill., from the intestine of sheep (N.S.W.); (3) *Trichosoma retusum* Raill., from the intestine and the submucosa of the oesophagus of a fowl (Sydney); (4) *Echinorhynchus* sp., from the subperitoneal tissue of *Diemenia psammophis* var. *reticulata* Krft., (North-west of West Australia; collected by Dr. Cleland); (5) *Echinorhynchus* sp., from the outer coats of the intestine of *Diemenia textilis* D. & B. (Sydney; D. Fry); (6) *Thysanosoma giardi* Moniez, from the intestine of sheep (N.S.W.); (7) *Tetrarhynchus* sp., a small encysted larval

form from the intestinal walls, etc., of the red gurnard, *Chelidonichthys kumu* Less. & Garn., and of the flathead, *Platycephalus fuscus* (both from Port Jackson; collected by Thos. Steel); (8) *Echinorhynchus* sp., a spiny form from the two last-mentioned fishes (Port Jackson). None of the above, except No.6, had been previously recorded as occurring in Australia, No.6 having been recorded from West Australia, and doubtfully from New South Wales.

Mr. E. Cheel exhibited a living plant of *Orobanche cernua* Læf., (*Orobanchaceæ*) found on the roots of a cultivated plant of *Tropæolum pentaphyllum* Lam., (*Geraniaceæ*) in Mr. A. Yates' seed-testing nursery at Concord. Also a plant of groundsel infected directly from æcidiospores of *Puccinia tasmanica* Diet., developed upon a plant exhibited at last Meeting, showing the progress of the disease in thirteen days; no teleutospores had yet been found.

Mr. Fred Turner exhibited and offered observations on the following plants:—(1.) *Protea cynaroides* Linn., a remarkable and rare South African Protead, grown in the garden of the late Honble. Dr. James Norton, M.L.C., at "Ecclesbourne," Double Bay. The shrub is now about nine feet high, and this year is carrying five expanded flower-heads and several buds. Hitherto the plant has produced not more than two flower-heads annually for a number of years. It is worthy of note that Dr. Norton was the first to flower this remarkable plant in New South Wales. The flower-head shown was twelve inches in diameter, including the involucreal pink scales. (2.) A variegated form of *Evodia micrococca* F.v.M., grown in the garden at "Ecclesbourne," and named var. *marmorata* by the exhibitor. Last season the parent-tree produced a fair quantity of seed, and some of the resulting self-sown seedlings have developed variegated foliage, a state which Mr. Turner had not hitherto observed either in cultivated or naturally grown specimens. This indigenous Australian tree is fairly common in many of the coast districts of New South Wales and southern Queensland. (3.)

*Melilotus ornithopodioides* Pers., a European clover-like plant which had recently sprung up in several places in the Hay district, N.S.W. Like its congeners, it has a strong perfume due to the presence of coumarin, a chemical principle which pervades all parts of the plant. Although only of annual duration, it has some value as a forage plant, particularly in late winter, and early spring.

Mr. Fletcher showed a series of seedlings of *Angophora cordifolia*, exhibiting anomalous cotyledons — polycotyledony, one cotyledon "split," fused cotyledons, and splitting followed by fusion.

## THE ADVENTITIOUS ROOTS OF *MELALEUCA LINARIIFOLIA* Sm.

BY C. T. MUSSON AND W. M. CARNE, HAWKESBURY AGRICULTURAL COLLEGE.

(Plates xviii.-xix.)

It has long been noticed at Richmond, N. S. Wales, and near Sydney, that the Swamp Tea-tree (*Melaleuca linariifolia* Sm.) has its very papery bark more or less covered and interpenetrated by fine, irregularly branching growths having all the appearance, at first sight, of some climbing plant making free use of the stem as a support. In reality they are outgrowths from the stem, which, growing through the bark now reach the air, travel over the tree for varying distances, then re-enter the bark and end, usually, low down therein close to the wood; probably only now exposed through wearing away of the outer bark. Within the bark they flatten out, and branch in such a way as to accommodate themselves to a necessarily restricted location between the bark sheets, which are sufficiently loose to allow of their penetration in any direction. These adventitious roots arise below the cambium, and are covered with a protective bark very similar to that of the twigs, their centres being occupied by a cylindrical fibro-vascular strand. From one to three feet in total length, even longer in some cases, they vary in diameter from less than 2 mm. to as much as 1 cm.; in some cases they assume even stem-like dimensions; for in a few old trees such growths, arising at some point in the stem 10 or 12 feet above the ground, have eventually reached it, struck root, and become Banyan-like secondary stems, though remaining closely appressed to the parent-stem. A few of the smaller growths arising near the ground have also entered it and struck root. The distal ends of these bark-penetrating root-growths show nothing resembling hairs or a root-cap; they are paler in colour than the rest of the enclosed root, which is

reddish, like the unexposed bark-layers; the terminal cells are loosely compacted and free from any protective covering. On stripping away the stem-bark down to near the wood, the course of these growths is readily traced to both terminals. Within the lower layers of bark, there is a rapid accumulation of watery liquid which forms blister-like swellings. In seeking a cause for these exceptional growths, we need to consider the conditions under which the trees live. Usually found near watercourses or in swamps, these trees are seldom found away from such locations as allow of their becoming surrounded by water after heavy rain, with the consequent filling of creeks and waterholes. The trees may stand for months actually in water; whilst, on the water disappearing, their location may dry out, leaving them to battle through periods of drought. They have, therefore, to contend with two very opposite sets of conditions as regards water-supply, shortage, even to almost complete absence; and, at the other extreme, actual flooding which may endure for months. It is worthy of note that these conditions operate with respect to certain Eucalypts, Casuarinas, and other species of *Melaleuca*; adventitious roots have, however, only so far been seen on the tree under notice. It would be interesting to know the actual root-conditions especially with regard to root-hairs, as to quantity and variability in number during the extremes referred to; also whether any symbiotic organisms exist thereon; and if so whether there is any correlation between their presence and the conditions of habitat. Fungus mycelium is commonly found here on roots of many and diverse plants; its presence may have a special significance in relation to our soil and climatic conditions. With respect to the part played by these adventitious roots in the life of the tree, several suppositions present themselves. They may function as aërating organs, though the extremities are never exposed directly to the air, being always hidden beneath the bark layers. The stilt-roots of the Mangrove are probably not analogous.\*

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\*"Respiration in the roots of Shore-plants," Dr. J. Banoroff, Report Aust. Assocn. Adv. Science, Sydney, 1887, vol. i. p. 327.



These Tea-tree adventitious roots can hardly be air-passages, for they arise, as do true roots, not in the bark, but from beneath the cambium; therefore, connecting with the tissues in use for conveyance of sap upwards. Their place of origin and the peculiar situation of their terminations seem to indicate that they are in some way connected with the tree's water-supply; possibly they are a means for reinforcing it at certain times from the stores in the lower layers of bark. Our observations have been made during the last few years, which have been noticeably dry; the outgrowths appear as dry as the outer bark; though, as stated, there is a plentiful supply of moisture deep down in the bark. The trees have suffered much through the continuous dry seasons; and are very bare of leaves; apparently a flooded period is required to restore them thoroughly to full vigour.

A third possible explanation suggests that these outgrowths may be of no special present use, but have been so in the past; that they are vestigial organs. It has been stated that "adventitious roots occur in places where the atmosphere is warm, stagnant, and loaded with moisture;" these conditions would be present for considerable periods when these trees stand in water, as we have seen to be the case for months together. The fact that such root-growths seek the dark recesses of the bark is quite natural, if they are really absorbing organs approximating in function to true roots; though in this case their action will be like that of hairless roots in water, absorption taking place through the loose unprotected cells at their extremities.

These roots should also be compared with those of the Moreton Bay and other fig-trees; those of the latter striking directly into the air, and remaining there. Taking all the circumstances into consideration, it is believed that these adventitious roots are of assistance in the general upward sap-circulation, performing auxiliary duties at some special time, most likely during one of some particular stress. This may be when the soil-roots are completely immersed in water, and are perhaps unable to function properly; at such times it is possible that these roots take up the

duty of supplying water to the higher parts of the tree; or it may be that they operate specially during drought. We are disposed to think the former is the more likely.

We have not succeeded in finding any published references to the occurrence of adventitious roots in any species of *Melaleuca*.

#### EXPLANATION OF PLATES XVIII.-XIX.

##### Plate xviii.

##### *Melaleuca linariifolia* Sm.

Photograph of portion of a stem, showing the bark with "adventitious roots;" in the lower part the outer bark has been cut away to show the penetrating habit (College Farm).

##### Plate xix.

Photograph of an old tree (Rickaby's Creek) showing Banyan-like arrangement of large adventitious roots, which have become stems through entering the soil and rooting.

## ON SOME EXPERIMENTS WITH DRAGONFLY LARVÆ.

By R. J. TILLYARD, M.A., F.E.S.

During the past few years I have kept and reared a large number of dragonfly larvæ of various species. The present paper is an attempt to collect together, in the form of a short narrative, the notes I have made about them concerning three points only, viz.:—longevity, resistance to starvation, and resistance to drought. The chief experiments carried out were made with (1) an unknown Libellulid larva of very peculiar structure, (2) a number of larvæ of *Synthemis eustalacta* Burm. I shall deal with these separately.

### i. The unknown *Libellulid* larva.

On October 10th, 1908, I dredged from the loose trash (consisting mainly of half-decayed vegetable matter such as eucalypt leaves) which collects in the small pools of the Heathcote Creek (Illawarra district, N.S.W.), a large number of larvæ of *Austrogomphus ochraceus* Selys. Together with these, I found two remarkable larvæ of Libellulid form, which I am quite unable to recognise as belonging to any known species. They are very hard, and when touched, curl up into a half-ball, remaining motionless for a considerable time. They have very short legs, a somewhat triangular head, a broadly oval body absolutely flat on the underside, and a deeply and very irregularly indented labium. At the time I took them, I was already acquainted with the larvæ of every dragonfly occurring in the neighbourhood, except that of *Synthemis flavoterminalis* Martin, so that it was not unreasonable to expect that this was the larva of that species. However, I have since taken, and bred out, the larva of *S. flavoterminalis*, which is of an absolutely different type to the one

under our notice. I must content myself, therefore, with calling it larva X, and trust that in course of time I may be able to breed it out and solve the problem.

Of the two larvæ taken, one was killed and mounted for my collection. It is interesting to note that with this hard-skinned larva, I was able simply to drop it into boiling water, pick it out again, and mount it on cardboard, without any shrinking or change of shape taking place. The specimen is to-day exactly as it was on first mounting, and in perfect preservation. It was nearly full-fed, judging by the size of its wing-cases, which reached to the end of the third abdominal segment. The second specimen, which I kept alive, was not quite so large, and had somewhat smaller wing-cases.

During three succeeding visits to Heathcote, in October and November, 1908, I was very disappointed at failing to obtain another specimen of this peculiar larva. Nor have I succeeded during 1909 and 1910, in obtaining a single specimen, though I have carefully dredged the creek several times. Nor have I, amongst the numerous exuviae collected, ever found this species.

I did not doubt, for a moment, when I first placed this larva in a small jar for observation, that I should succeed in breeding it out during the summer of 1908-09. I supplied it with plenty of food, chiefly mosquito-larvæ and small insect-larvæ picked out of the trash of the creek-bed. In the jar there was plenty of water-weed growing, and a strong stick was placed in an upright position for use on emerging. The larva settled at the foot of this stick *head downwards*, ate three mosquito-larvæ which I drove almost into its mouth, and then remained in this position, day after day for weeks, without taking the slightest interest in anything. Once or twice I got up at midnight and found it climbing up the side of the jar or walking round the edge, so that I concluded that it was a nocturnal feeder.

By the middle of December, 1908, all the other larvæ which I had collected had emerged. The larva X was, however, still in its old position on the stick, had undergone no ecdysis, and did

not appear likely to emerge for a long time. As I was then leaving for Tasmania, I covered the jar with a muslin top, put in a good supply of food, and left it.

I returned on January 25th, 1909. I found the water in the jar almost evaporated, the water-weed growing rather thickly on the damp sand, and the larva still in the same position on the stick, but with its head partly buried in the damp sand. It was evident that it could withstand these semi-drought conditions; so I allowed them to continue for nine weeks, viz., up to the end of March. During that time, I sprinkled water on to the sand with my fingers about once a week, so that the sand did not get absolutely dry, nor did the weed completely die away. No food of any kind was supplied to the larva, which evinced no desire even to move, much less to feed. On April 2nd, fearing that a continuance of these conditions might prove too much for the larva, which I did not wish to lose, I filled up the jar with tap water. As the larva still remained in its old position, I did not put any food in, but left it to itself throughout the winter. Though I watched it very often, both night and day, it never once changed its position, nor showed any sign of life.

It remained thus until the end of September, 1909. By this time the water-weed was growing again, and a good crop of duck-weed covered the surface of the water. The temperature of the water was now considerably higher than during the winter. On September 29th the larva awoke from its long period of hibernation, and began wandering round the jar. I put in a number of mosquito-larvæ, but the dragonfly larva seemed frightened at them, and kept continually backing away from them. However, when at last I managed with a stick to drive one wriggling straight to its head, it snapped at it and swallowed it whole. I succeeded in getting it to eat two more. At night I noticed it to be on the look-out for food, and I have no doubt it secured a good meal. During the next few weeks it usually occupied a position on the stick, sometimes head downwards and sometimes head upwards; occasionally half-way up, but usually at the base of the stick.

Meanwhile its colour darkened from a semi-transparent brown to a dark opaque blackish-brown, indicating the approach of an ecdysis. On November 3rd it changed its skin. I was fortunate in seeing the change, which occurred in the early morning and took a considerable time—nearly an hour. The larva on emerging from its skin was of a very pale green colour, but on my return in the afternoon it was quite brown again. I do not know of any other dragonfly larva in which the skin hardens and darkens so quickly after ecdysis.

I now had hopes that this larva, already more than a year old, would emerge during the summer of 1909-10. But although it was plentifully supplied with food, it seldom took a meal, and grew very slowly. By the beginning of March it had settled down again in its old position at the base of the stick. Though it occasionally wanders about at night, it keeps in one position during the day. To-day (June 11th, 1910) it is still quiescent. As it is now nearly midwinter, it will evidently not emerge until October or November, at the earliest.

The conclusions I make from these observations are:—

(1) As regards *longevity*. Dragonfly larvae of some species can, and do, live for more than a year; under adverse conditions, they can live more than two years. Even supposing that the ovum from which the larva X sprang was laid as late as February, 1908, and hatched, say, in March, this larva is now *two years and three months old*. And as it was already so far grown, when I took it in October, 1908, as to possess small wing-cases, I do not think we can possibly suppose that it was hatched later than March, 1908.

(2) As regards *resistance to starvation*. The larva X certainly had no food from January 25th, 1909, to September 29th of the same year, *i.e.*, for *eight months*; and probably it had gone without food for a month previous to January 25th, during my absence from Sydney.

(3) As regards *resistance to drought*. The larva X, taken from a clear mountain-stream which is never dry, withstood a considerable degree of drought for *nine weeks*. As I did not allow

the sand to dry up completely, so as to cake into a hard mass, we cannot say from this that it could have survived a more vigorous drought. But in its natural haunts, supposing at any time a long-sustained drought had occurred, there would have been at times a fall of dew which would have served the same purpose as the sprinkling of water which I gave once a week.

ii. The larvæ of *Synthemis eustalacta* Burm.

About twenty of these were obtained from a swamp at Laura, Blue Mountains, on October 1st and 2nd, 1909, together with about a dozen larvæ of *S. macrostigma* Selys, all from one-half to three-quarters grown in size. As these larvæ are incapable of climbing out of a deep glass aquarium, I placed them in a specially designed circular tank, one yard in diameter, with sides only six inches high. From two to three inches of sand covered the bottom all over, rocks were placed here and there, clumps of water-weed planted, and the tank filled with water to within half-an-inch of the brim. A large quantity of duck weed was placed on the water, and clumps of reed and sedge placed so that the larvæ could climb up and emerge.

In the previous year, nearly all my larvæ of these two species died through inability to emerge from a deep aquarium when full-fed. During November and December, 1909, however, all the larvæ of *S. macrostigma* emerged, and also many of the *S. eustalacta* larvæ. There were, as a matter of fact, eight of the latter larvæ in the tank on December 25th, 1909, together with two *Hemicordulia tau* and a few small *Agrionid* larvæ (*Pseudagrion cyane*). I determined to subject these to a rigorous drought and starvation process. To do this naturally, no more food was put in, and the water was allowed to evaporate of its own accord. Also, in the centre of the tank, two flat rocks were arranged, so that one leaned slantwise on the other, forming a small "haven of refuge," which I could at any time examine, by lifting the slanting rock, without disturbing the larvæ.

By February 2nd the water had all evaporated, but the sand was still very damp, especially around the rocks. A week later

all the *Agrionid* larvæ, and the two *Hemicordulia tau*, were dead—stretched, flat and dried up, on the sand\*. In the "haven of refuge" three larvæ of *S. eustalacta* had settled down into the damp sand. The other five were wandering round the tank searching for damp corners, under the rocks. I noticed that they appeared to be considerably annoyed by a tiny fly which settled often on their backs. It will be interesting to find out whether the larva of this fly is a parasite on the living dragonfly larva.

On February 16th, there was only one *S. eustalacta* larva in the "haven of refuge." This one was caked all over with dry sand, and I picked him up and examined him. He was quite vigorous, and ran across my hand. I put him back again, and noticed that the other two had crawled to the edge of the tank and had got partly under the shelter of a large flat rock near the edge. The sand was now absolutely dry, and caked hard. The tank was left without observation from this date until Good Friday (March 25th). On that day I turned up the slanting rock in the centre, and found the same larva of *S. eustalacta* sitting under it in exactly the same position as when I left it. It was quite lively, and ran vigorously across my hand. It appeared very hard and dry, caked with sand, but not at all shrivelled or reduced in size. I then turned up the other rocks, and discovered three more larvæ of the same species, firmly set into the dry sand. These came out like dry hard lumps in a cake of sand. They were absolutely inert, and to all appearances dead, but not shrivelled, and only a little reduced in size. I dropped these three into a jar of water. Two of them revived immediately, and swam to the bottom of the jar, where they buried themselves at once, with just their heads and anal ends appearing above the sand. The third larva floated on the water for half-an-hour, when he suddenly revived and descended to the bottom of the jar, where he sat on the sand without attempting to bury himself.

\* It is interesting to note that before the very dry winter of 1907, huge swarms of *Hemicordulia tau* appeared during March and April all over New South Wales. Many followed the watering-carts in Sydney for weeks, and the occurrence was noted in the daily press.



These three larvæ were supplied with a jar full of mosquito larvæ (about two or three hundred). As these wriggled past them, they seized and ate with the utmost greed all that they had time to catch. One larva ate over fifty mosquitoes in ten minutes, but after that refused to eat any more until the next day. These larvæ are now in one of my large aquaria; are feeding well and appear to be nearly full-fed; but I do not now expect them to emerge until next November.

The remaining larva was again returned to his place under the middle rock\*. The tank was then left without observation for just over five weeks, i.e., until Sunday, May 1st. On lifting the middle rock on that date, I found that the larva had deserted his old haunt. I examined the other rocks, and found him buried flat under one of them, so I carefully replaced the rock upon him. I was quite unable to find any other larvæ, though I knew that there should be three or four more somewhere.

Another month was now allowed to pass. On May 29th I again lifted the rock under which I had left the larva. It was still there, but appeared somewhat shrivelled and inert. Fearing that it had about reached the limit of endurance, and desiring to preserve it and breed it out at a later date, I now removed it and dropped it into an aquarium. It revived at once, swam to the bottom, and began a vigorous onslaught on the mosquito-larvæ with which I supplied it. It is to-day alive in the aquarium and feeding well.

Regarding the experiment now as practically ended, I removed and examined all the rocks. I found no larvæ under any of them. I then took a watering-pot and watered the sand all over until it was soaked completely through. In a few minutes bubbles appeared in various places, and there crawled out two or three specimens of a small dark centipede, several small red worms of a kind I have often seen in fresh-water ponds, and four

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\* This larva was kept in a small box of dry sand from Friday, April 25th, to Wednesday, April 30th, and was exhibited on the latter date at the meeting of the Linnean Society. Vide Proceedings *antea*, p. 48.

*more larvae of S. eustalacta*. These latter were placed in a separate aquarium. Three of them attempted to swim downwards, but could not, as their bodies were so light. They then took up a position similar to that adopted by *Notonecta*, walking under the surface of the water, with legs uppermost. In this position they caught and ate a fair number of mosquito-larvæ. A few hours later they managed to swim to the bottom. It was ludicrous to see their attempts at covering themselves with sand. No sooner had they heaped a fair quantity on to their backs, and striven to settle down flat in it, than the buoyancy of their bodies overcame them, and they rose helplessly up into the water. To-day, a fortnight later, only one has so far succeeded in burying itself. The other two sit on the lead at the corner of the aquarium and feed quite contentedly.

Finally, the fourth larva floated, to all appearance dead, for six hours. It then showed signs of life, and adopted the *Notonecta* attitude. It remained thus for five or six days, feeding well. It is now able to crawl about in the water-weed, but is still too buoyant to keep on the sandy bottom.

Of the eight larvæ I now possess, which have passed through this trying ordeal, I trust that some will emerge next summer. It will be most interesting to see the effect of their experiences on the size and colour-pattern of the resulting imagines.

I should like to add that I was most careful to test the dryness of the sand, *below the surface*, by digging; and satisfied myself that on February 16th the sand was *absolutely dry and caked hard throughout*, right down to the bottom of the tank. (The total depth of sand was only three inches).

The chief conclusion to be drawn from this experiment is that the larva of *Synthemis eustalacta* possesses the power of resisting drought to a most remarkable degree. This is all the more surprising, inasmuch as none of the species of this genus are found in the drier parts of Australia. On the Blue Mountains, where I obtained the larvæ, the *average* rainfall is very heavy, ranging from 30 to over 50 inches per annum. Droughts, however, of some duration are known to occur. The test that I

applied, which amounted to a severe drought of ten weeks' length, without even the help of a single fall of dew through the whole period, is, I think, sufficient to prove that the members of this genus can easily survive the driest conditions they are ever likely to meet with in their natural habitat. This is of great interest, since I have noticed that most dragonfly larvæ, such as nearly all the *Æchnidæ* and *Agrionidæ*, with not a few of the *Libellulidæ*, perish as soon as the pond or river containing them dries up. It may go far to explain the peculiar success of the *Synthemis*-type in Australia, and the manner in which they have survived and successfully held their own against more highly evolved types in all parts of the continent. As regards those few *Libellulidæ* which appear to have established themselves permanently in the desert belt of Central Australia (and whose larvæ therefore we might expect to possess a drought-resisting power superior to that of *Synthemis*), we are not yet in a position to know whether it is really their larvæ which withstand drought, or whether the imagines themselves may not scatter far and wide over the heated sandy plains, and so always keep the race alive over a large area, by ovipositing in whatever waterholes may happen to contain water at any given period. As far as I know, only *Orithetrum caledonicum* and *Diplacodes hæmatodes* occur commonly over the whole of Central Australia; and these two dragonflies are noted above all others in Australia as being *sand-lovers*. Even in well watered regions they seek out the dry patches of sand and settle on them in hundreds. Also, whereas the seasonal range of the imago in *Synthemis* is comparatively short (from the end of November to the end of February), that of the above-mentioned species is long. They occur all the year round in tropical parts, and in New South Wales they may be taken from early in September right up to the beginning of June.

The experiment also shows that the larvæ of *Synthemis*, when conditions are unfavourable to development, can and do remain alive for more than one year. As *S. eustalacta* is only on the wing from November to February, and most of the ovipositing is

done before February, these larvæ must at any rate have been hatched by March. So that they are now *fifteen months old*.

As regards resistance to starvation, these larvæ went without food for about three months, and I have no doubt could endure a longer fast if necessary. Often, in the winter, their mountain haunts are frozen up, and they are compelled to go without food. As regards *S. macrostigma*, which inhabits the thick mud at the *edge* of a mountain bog, it is probable that it is often completely enclosed in the hard cake of frozen mud in which it lives, without being any the worse for it.

In conclusion, I find that, as far as my experiments go, most dragonfly larvæ can go without food for long periods. I suspect that many others besides those which were made the subject of these experiments are able to exist as larvæ for two or even three years. I do not, however, think that many can resist drought; that is a power possessed only by a few *Libellulidæ*, and possibly also by *Petalura* and *Argiolestes*.

POSTSCRIPT (*added 18th October, 1910*).—Since this paper was read, much that is of interest has occurred with regard to the unknown *Libellulid* larva mentioned therein. By the middle of September it appeared quite full-grown, and on several successive days it moved up the twig and rested partly out of the water. However, the weather not being very warm, it returned again to the bottom of the jar, and became very listless and inert. On October 7th, it emerged from the water, and climbed well up the twig, resting some three inches above the surface of the water. There it remained all day, unable to effect the final change. The weather was rather cold and exceedingly windy, so that it was unfortunately by no means a good day for a successful emergence. On my return home I found that the larva had fallen off the twig dead. Its thorax was much swollen, and the parts of the head were dry and partly cracked; so that it was evident that the final change had begun, but that the larva had lacked strength to complete it. How far this failure was due to unnatural conditions I cannot say, for the larva was quite strong and healthy until a few days before it died.

I was much disappointed at this failure to breed out such an interesting larva, after having kept it just over two years. However, I carefully removed the wing-cases from it, and, with some trouble, I was able to stretch out the wings nearly to their full size, and to sketch all the important parts of the venation. As a result of a short examination of them, I am able to state that the larva belongs to a hitherto unknown species of the subfamily *Corduliinae*, which will form the type of a new genus allied to *Syncordulia*. It is strange that, after having collected carefully at Heathcote for so many years, and at so many different times of the year, I have not yet met with the imago. To obtain it will now be one of my principal aims.

I visited Heathcote again on October 1st of this year, for the purpose of obtaining more of these larvæ. Careful dredging for some hours yielded no results, but finally, amongst a large collection of trash washed down by the rains into a deep pool, I found no less than six of them. They are all small, the largest being smaller than the one I originally found on October 2nd, 1908. These are now in my aquarium, and will be watched with great interest. They will probably take two, or possibly three, years to reach maturity.

# THE HÆMATOZOA OF AUSTRALIAN REPTILIA. No.1.

By T. HARVEY JOHNSTON, M.A., B.Sc., AND J. BURTON CLELAND,  
M.D., CH.M.

(From the Bureau of Microbiology, Sydney)

(Plate xx.)

In connection with our systematic researches upon the hæmatozoa of Australian vertebrates, we propose to deal from time to time with those met with in reptiles, this paper forming the first part. We consider it advisable to begin our paper with a list of Australian reptilia from which hæmatozoa have been already recorded.

## CHELONIA (Turtles, Tortoises, etc.).

1. *Chelodina oblonga* Gray—*Hæmogregarina clelandi* Johnston,\* Perth, Western Australia.

2. *Chelodina longicollis* Shaw—*Trypanosoma chelodina* Johnston;† South Australia. *Hæmocystidium chelodine* Johnston and Cleland;‡ Sydney.

## OPHIDIA (Snakes).

3. *Python amethystinus* Schn.—*Hæmogregarina (Karyolysus) amethystina* Johnston.§

\* Johnston, T. H., "On some Hæmogregarines from Australian Reptiles." Proc. Linn. Soc. N. S. Wales, 1909, xxxiv., pp.407-8. The host given was *C. oblonga*(?) and has since been identified by Mr. A. R. McCulloch as belonging to that species.

† Johnson, E. A., Australasian Medical Gazette, 1907, xxvi., p.26. Summary given in Johnston, l.c., pp.408-9.

‡ Johnston, T. H., and Cleland, J. B., "On a new Melanin-producing Hæmatozoan from an Australian Tortoise." Journ. Proc. Roy. Soc. N. S. Wales, 1906, xliii., pp.97-103.

§ Johnston, T. H., "On a new Hæmoprotozoan." Rec. Austr. Museum, vii., 1909, pp.257-9.

4. *Python spilotes* var. *variegata* Gray—*Hæmogregarina* (*Karyolysus*) *shattocki* Sambon and Seligmann;\* (Queensland). *Hæmogregarina* (*Karyolysus*) *moreliæ* Johnston;† West Australia.

5. *Python spilotes* Lacép.—*Hæmogregarina* (*Karyolysus*) *shattocki* Sambon and Seligmann;\* (N. S. Wales).

6. *Pseudechis porphyriacus* Shaw—*Hæmogregarina* (*Karyolysus*) *pseudechis* Johnston;‡ (N. S. W.).

7. *Diemenia textilis* Dum. & Bibr.—*Trypanosoma* sp. (‡)§; (Queensland).

The following is a list of species examined by us, but in which hæmatozoa were not found. The dates, localities, and number examined are mentioned.

#### OPHIDIA.

*Acanthophis antarctica* Shaw (the death-adder); Sydney, June, 1909,(1).

*Diemenia textilis* Dum & Bibr.(the brown snake); Richmond, November, 1909,(1); Sydney, August, 1910,(1).

*Diemenia psammophis* Schl.(the whip-snake); Queensland, July, 1910,(1).

*Notechis scutatus* Peters (the tiger-snake); Sydney, May, 1909,(1); Sydney, June, 1909,(1).

*Typhlops polygrammicus* Schl.(the blind snake); Sydney,1909(1).

#### LACERTILIA.

*Lygosoma* (*Hinulia*) *tenue* Gray; Hunter River, Feb.,1910,(1).

*Lygosoma* (*Hinulia*) *teniolatum* White; Moree, Oct., 1909,(1).

\* Sambon, L. W., and Seligmann, C. G., Proc. Zool. Soc. Lond., 1907, p.284; Sambon, L. W., Trans. Pathol. Soc. Lond., 1907, lviii., p.310; Johnston, T. H., Proc. Linn. Soc. N. S. Wales, 1909, xxxiv., pp.402-4; Dobell, C. C., Parasitology i. (4), 1908(1909), p.291; Sambon, L. W., Journ. Trop. Med. Hygiene, xii., 1909, pp.111-3.

† Johnston, T. H., l.c., pp.404-6.

‡ Johnston, T. H., l.c., p.406.

§ This record is based on the following extract from the Australasian Medical Gazette, xxv., 1906, p.408—"Dr. Love exhibited under the microscope a Trypanosome from the blood of a brown snake sent by Dr. Tyrie."

*Lygosoma (Liolepisma) guichenoti* Dum. & Bibr.; Sydney, July, 1910,(1).

*Lygosoma (Lygosoma) ophioscincus* Boulenger; Hawkesbury R., January, 1910,(1).

*Pygopus lepidopus* Lacép.(the slow-worm); Sydney, December, 1909,(1); June, 1910,(1).

*Tiliqua scincoides* White (the blue-tongued lizard); Sydney, April, 1909,(1); July, 1909,(1); October, 1909,(1); December, 1909,(1); Hunter River, February, 1910,(1).

*Amphibolurus muricatus* White (the common dragon); Sydney, July, 1909,(2); Sydney, March, 1910,(1).

*Amphibolurus barbatus* Cuv.(the jew-lizard or bearded dragon); Sydney, January, 1910,(1); Hunter River, February, 1910,(1).

The following species have been examined by us and found to harbour hæmatozoa :—

#### CHELONIA.

1.*Chelodina oblonga* Gray,(a fresh-water tortoise); Perth, West Australia, 1908; hæmogregarines (*H. clelandi*) in one examined.

2.*Chelodina longicollis* Shaw,(the long-necked tortoise); Sydney, April, 1909. *Hæmocystidium chelodinae* in one out of two examined.

3.*Emydura krefftii* Gray; Queensland, April, 1910. One out of two examined harboured the following hæmatozoa—*Trypanosoma* sp., *Hæmocystidium* sp., and *Hæmogregarina* sp.

#### OPHIDIA.

4.*Python amethystinus* Schn.,(the northern carpet-snake); Port Curtis, Queensland, January, 1909; hæmogregarines (*H. amethystina*) in one examined.

5.*Python spilotes* var. *variegata* Gray, (the carpet-snake); Enoggera, Queensland, April, 1909, hæmogregarines (*H. shattocki*) in one out of three examined); Abrolhos Archipelago, West Australia, 1908, hæmogregarines(*H. moreliæ*) in one examined.

6.*Pseudechis porphyriacus* Shaw,(the black snake); Sydney, June, 1909, hæmogregarines (*H. pseudechis*) in one out of three; Richmond, 1909,(1—nil); Sydney, December, 1909,(1—nil).



7. *Diemenia psammophis* var. *reticulata* Krefft (the spinifex-snake of West Australia, a variety of our local whip-snake); West Australia, 1908, *Hæmogregarina* sp., in one examined.

8. *Dendrophis punctulatus* Gray, (the green tree-snake); Queensland, 1907, hæmogregarines (*H. dendrophidis*) present in one examined.

#### LACERTILIA.

9. *Varanus varius* Shaw, (the lace-lizard or monitor), Sydney, April, 1909, (1—nil); Bingara, December, 1909, hæmogregarines (*H. varanicola*, n.sp.) in one examined; Cronulla, March, 1910, (1—nil).

10. *Lygosoma (Hinuia) quoyi* Dum. & Bibr.; Hawkesbury R., November, 1909, hæmogregarines (*H. hinuice*) in one examined; Hunter River, February, 1910, (1—nil).

Our thanks are due to the following gentlemen for sending us either reptiles or reptilian blood-films—Dr. T. L. Bancroft and Mr. H. Wasteneys of Queensland; Messrs. S. J. Johnston, F. H. Taylor, A. R. McCulloch, D. Fry, and H. Cawley; and also to Mr. McCulloch for his kindness in assisting us in regard to the nomenclature of the various specimens.

#### HÆMOGREGARINA (*KARYOLYSUS*) *DENDROPHIDIS*, sp. nov., from *Dendrophis punctulatus* Gray.

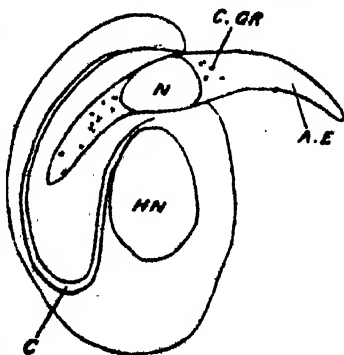
(Plate xx., figs. 1-8.)

Dr. T. L. Bancroft recently forwarded from Queensland to us some blood-films labelled "Drepanidia from the green tree-snake, *Dendrophis punctulatus* Gray, 10/12/07." The erythrocytes were heavily parasitised by a hæmogregarine belonging to the subgenus *Karyolysus*, which varied in size from 0.009 by 0.0015 mm. to 0.018 by 0.002 mm. The youngest forms were delicate thin crescents with rather pointed ends, and a well defined nucleus situated centrally. Somewhat older forms (about 0.018 mm. long by 0.002 mm. broad) were broader, their ends being blunt and rounded. The nucleus was usually placed nearer one end (the posterior) and varied in size and shape. Sometimes it was narrow and band-like, at others an elongate and more or less rounded

structure. A capsule could be distinguished surrounding most of the forms.

Still older hæmogregarines were present in the films. They showed the presence of a short though distinct "tail" lying bent round on the concave side of the "body." The nucleus was large and as a rule situated near the bend. These tailed forms reached 0.018 mm. in length (measuring along the midline and including the tail). The surrounding capsule was usually recognisable. A few very broad but relatively short capsulated forms (0.013 by 0.004 mm.) were also present. Here the nucleus was large, and rounded. A fact worthy of mention is that the protoplasm of these hæmogregarines frequently showed the presence of relatively large chromatic granules staining a deep blue. These granules were situated in the vicinity of the nucleus, being scattered between it and the posterior end of the parasite as well as in the immediate vicinity of the anterior border of the nucleus. In all cases observed it was noticed that the other end of the organism remained free from them.

The infected cells were usually longer and narrower than normal, and the host-nucleus was frequently displaced, sometimes coming to lie at the side of the corpuscle. No cell was seen in which the nucleus had been ejected. A few cases of double infection were observed. Some parasites were found lying free, but very probably they had been set free by the rupture of the parasitised cell. One very interesting parasite was seen in process of extrusion



Text-fig. 1.

A.E., anterior end of parasite—C., capsule—C.G.R., chromatic granules—H.N., host-nucleus—N., nucleus of parasite.

from its host-cell, probably as the result of artificial manipulation. The anterior half of the hæmogregarine (text-fig. 1) projected

from the surface of the red cell, while the posterior half with the nucleus still remained within. The tail was now straightened instead of being bent on the body, and the parasite presented the typical form of a narrow, elongated, slightly curved body whose ends tapered gradually and fairly equally, and showed its well marked nucleus and deeply stained blue granules. The "capsular area" formerly occupied by the parasite in its host-cell was readily distinguishable, as the accompanying camera-lucida sketch shows.

The type-slide of *Hæmogregarina (Karyolysus) dendrophidis* has been deposited in the Australian Museum, Sydney.

*HÆMOGREGARINA (KARYOLYSUS)*, sp., from *Diemenia psammophis* var. *reticulata* Krefft.

(Plate xx., figs. 9-12.)

Blood-films taken by one of us, 1907, from a "spinifex-snake" (*Diemenia psammophis* var. *reticulata* Krefft) in the north-west of West Australian, were seen, on examination, to contain abundance of hæmogregarines in the red corpuscles. The preservation was imperfect, and consequently only an incomplete account can be given. The parasites were relatively large, being from 0.014 to 0.016 mm. long, by about 0.004 mm. broad. They were fairly uniform in size and shape, being mostly kidney-form, the concavity closely approaching the nucleus of the host-cell. The ends were generally broad and rounded, and of about the same size, though in some cases one end was rather narrower than the other. In a few forms there was a slight bulging near the midregion, and it was here that the band-like nucleus, when recognisable, was seen to be situated. Some of the organisms showed the presence of a small "tail" bent round upon the "body," but very little detail could be recognised. A capsule was detected in a few instances. Most of the infected cells were scarcely, if at all, enlarged, and their nuclei were usually only slightly displaced, even by parasites occupying nearly half the erythrocyte. In some cases the nucleus was seen to be pushed over to the edge of the red cell, and in a few instances was not present at all, having

probably been ejected. Double infection of a cell appeared to be rare. In one case noticed the parasites were large adults, and there was scarcely any space left unoccupied in the extranuclear protoplasm of the host. The nucleus was here pushed to one side, but did not show any signs of degeneration.

Films from this snake were sent to Professor Minchin for examination.

*HÆMOGREGARINA (KARYOLYSUS) VARANICOLA*, n.sp.

(Plate xx., figs. 13-16.)

Blood-smears taken by Mr. Allan McCulloch, of the Australian Museum, from a monitor lizard, *Varanus varius* Shaw, shot by him near Bingara, New South Wales, in December, 1909, were examined by us, and the presence of a few hæmogregarines in the erythrocytes was revealed.

The parasites were relatively large, the more or less rounded forms being 0.0135 mm. long, by about 0.004 mm. broad. "Tailed" forms, measured along the middle, were from 0.0167 to 0.018 mm. long, by 0.003 to 0.004 mm. in maximum breadth. A few resembled crescents with broad rounded ends, the concavity facing the nucleus in some instances but remote from it in others. Usually the central portion of the concave face was considerably swollen to form the broadest part of the hæmogregarine. In a few forms the parasite possessed a broad end (regarded as anterior), the other gradually narrowing to terminate in a fairly wide "tail" with a rounded extremity. This tail was bent round to lie in almost the same direction as the "body." The nucleus was either a broad band or a more or less rounded structure lying towards one end, in the case of tailed forms, the position being at about the point where the "tail" commenced to bend round. Some of these sporozoa showed the presence of a well-marked capsule, this being easily seen in the tailed forms, a distinct space being recognizable between the "tail" and the "body." Neither free nor segmenting stages were recognised.

In none of the infected cells was any distortion of form seen, though in all cases the host-nucleus was displaced from its normal

positions. It usually lay against the side of the erythrocyte, the parasite occupying a large part of the extranuclear area, especially the centre. Probably, as the hæmogregarines become more mature, the host-nucleus would be ejected, as frequently happens in reptilian blood cells infected by members of this group. Some of the infected cells appeared larger than normal, but not markedly so.

The presence of a "tail" and the effect produced on the host-cell, show that the organism belongs to the subgenus *Karyolysus*. The name *Hæmogregarina (Karyolysus) varanicola* is proposed for this parasite. The type-slide has been presented to the Trustees of the Australian Museum.

*Varanus varius* ranges over Eastern Australia.

HÆMOGREGARINA (KARYOLYSUS) HINULIÆ, n.sp.

(Plate xx., figs.17-20.)

This hæmogregarine was detected in blood-films from a skink, *Lygosoma (Hinulia) quoyi* Dum. & Bibr., shot at Nilson Island, Hawkesbury River, in March, 1909. Very few parasites were present, and these with few exceptions were all of the one form, being approximately kidney-shaped, as will be seen from the figures. The length was from 0.015 to 0.018 mm., the breadth, which was fairly uniform in each parasite, being from 0.005 to 0.0065 mm. In only one form was the presence of a tail distinguishable. In this parasite, which was partly extruded from the host-cell, one end was broad and rounded while the other tapered somewhat, to end in a "tail" which was bent round on the "body." This organism was much longer than any of the others seen, being about 0.025 mm. in length, the breadth at the anterior end being 0.0055 mm., decreasing to 0.0036 mm. just behind the nucleus, which in this case was located posteriorly near the point where the tail began to bend round. The nucleus itself in this specimen was square, with a side of 0.0035 mm., and showed in its centre a small clear spot occupied by a minute central dot. The nucleus in the other specimens, when seen, was a rather

small rounded structure lying towards one end and near the convex side of the animal. A closely investing capsule was distinguishable.

The parasite appears to exert a destructive influence on the host-cell. The infected erythrocytes were greatly enlarged, especially along their longitudinal diameter, the breadth remaining practically unaltered. In all cases seen, the hæmogregarine was placed lengthwise along the length of the host-cell; and the nucleus of the latter was seen to be displaced to such a degree that it either lay at one end of the red cell, or was absent, having apparently been ejected.

The type-slide of *Hæmogregarina (Karyolysus) hinulæ* has been deposited in the Australian Museum, Sydney.

#### EXPLANATION OF PLATE XVII.

Fig.1.—Normal erythrocytes of *Dendrophis punctulatus*.

Figs.2-8.—*Hæmogregarina dendrophidis* in erythrocytes of *Dendrophis punctulatus*.

Figs.9-12.—*Hæmogregarina* sp., in erythrocytes of *Diemenia psammophis* var. *reticulata*.

Figs.13-16.—*Hæmogregarina varanicola* in red cells of *Varanus varius*.

Fig.17.—Normal erythrocyte of *Lygosoma (Hinulia) quoyi*.

Figs.18-20.—*Hæmogregarina hinulæ* from blood of *Lygosoma (Hinulia) quoyi*.

Fig.18.—Parasitised cell minus nucleus.

Fig.20.—An encapsuled parasite seen lying free beside a crushed blood-cell.

POSTSCRIPT (added September 29th, 1910).—During the interval between the submission of this paper to the Society and its reading, two papers appeared in Proc. Roy. Soc. Victoria, xxiii.(n.s.), 1910, one, on pp.36-38, by Prof. Gilruth, describing (but not naming) a hæmogregarine from *Varanus varius* in Victoria; and another, by Gilruth, Sweet, and Dodd, dealing with some hæmatozoa, amongst them being a hæmogregarine(*H. megalocystis*, n.sp.) from *Python spilotes* var. *variegata*, from Victoria (pp.234-236).

WEDNESDAY, OCTOBER 26TH, 1910.

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The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, October 26th, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

The President announced that the Council was prepared to receive applications for three Linnean Macleay Fellowships, tenable for one year from April 1st, 1911, from qualified Candidates. Applications should be in the hands of the Secretary on or before 30th November, 1910, who will afford all necessary information to intending Candidates.

The attention of Members interested in Entomology was called to a circular giving particulars of the Prizes for the three best Essays or Papers "On the history, development, and present position of the Maggot Fly trouble in Australia, as it affects the sheep-growing industry," offered by Messrs. William Cooper and Nephews, of Berkhamstead, England, and O Connell Street, Sydney.

The Donations and Exchanges received since the previous Monthly Meeting, amounting to 17 Vols., 70 Parts or Nos., 12 Bulletins, 4 Reports, 3 Pamphlets, and 2 Maps, received from 56 Societies, &c., and one Individual, were laid upon the table.

## NOTES AND EXHIBITS.

Mr. T. Steel exhibited a remarkable bacterial growth forming a coating half an inch in thickness inside a pipe through which fermented molasses wash passed on its way to the still in a large Sydney distillery working molasses. The deposit consisted of bacteria, apparently in pure culture, mixed with a very few yeast cells.

Mr. A. F. Basset Hull exhibited skins of (a) *Oestrelata leucoptera* Gould, (b) *Eudyptula minor* Gould, and (c) *Pelagodroma marina* Latham; also eggs of the two latter species. These exhibits were collected during a visit to the Islands off the entrance to Port Stephens, N.S.W., on the 16th October instant. The *Oestrelata* was found on Cabbage Tree Island, the locality where Gould's type of the species was taken. The birds were discovered in considerable numbers, evidently mating and preparing their nests, but no eggs were found. Two of the birds taken contained nearly matured eggs. Gould, in describing this species, says "The Australian seas abound with Petrels, the investigation of the various species of which, their habits and economy, as well as their places of abode, will serve to occupy the attention of ornithologists for years to come." (Handbook, ii., p.455, 1865). It is somewhat of a reflection on the enterprise of local students that the nest, egg, and habits of this bird, breeding so near to Sydney, still remain undescribed. The *Pelagodroma* was found breeding in large numbers on the northern side of Broughton Island. In most cases the burrow contained a fresh egg, but two were found partly incubated. The *Eudyptula* was found breeding on Cabbage Tree Island. Nests contained slightly incubated eggs, or young in various stages of growth up to nearly full size of the adult, but still with some of the down adhering to the neck and shoulders. This constitutes a record breeding-place



of both species, 146 miles further north than the exhibitor's previous record of both breeding on Tom Thumb Islands, off Wollongong (These Proceedings, 1909, p.589).

Mr. Froggatt exhibited specimens of a curious fly (*Oncodera fumatus* Erichs.), which deposited its eggs in such numbers, upon the tips of apple-twigs in Mr. Richardson's orchard at Galston, that the buds died back and the twigs became quite black. Hundreds of the minute larvæ subsequently hatched out; of these, examples were exhibited. They are 13-segmented maggots, dark brown in colour, and covered with stout hairs. The head-segment is elongate-oval, smaller than the thoracic segments, which, merging into the abdominal segments, are broadly rounded to the anal segment. They progress by pressing the anal segment on the bottom of the box, and curving the body round like a bow, when they jump like cheese-mites. Nothing had been previously recorded of the habits of Australian species of this small but cosmopolitan family of the Diptera; but, in America, two allied species are, in the larval state, parasitic upon spiders; the larva attaching itself to the body of the spider, and then devouring it. Another fine dipterous species, *Pterodontia mellii* Erichs., was also exhibited; this is usually found on tree-trunks or stumps, so that it is probably parasitic upon large spiders found under the dead bark. Specimens of a large longicorn, *Demonethra helleri* Lam., and its larvæ, from the Solomon Islands, were also shown.

Mr. A. R. McCulloch exhibited, by permission of the Curator of the Australian Museum, two fishes which were previously unknown in Australian waters—a small shark, *Scyliorhinus marmoratus* Bennett, which had been taken at Port Darwin, N. Territory, and the other an eel, *Ichthyophaga zebra* Shaw, from Fremantle, W.A.

Mr. A. A. Hamilton exhibited a series of plants from unrecorded localities, comprising *Panicum glabrum* Gaud., (syn., *P. lineare* Krocke, *Paspalum ambiguum* DC.); Leura, Blue Mountains; March, 1910 (A. A. Hamilton). In the Proceedings of this Society for 1908 (p.344) Mr. Fred Turner recorded this Indian grass from

Vaucluse, and noted its rapid spread on the Vaucluse estate. The finding of this plant at Leura further demonstrates its capacity for acclimatisation.—*Eryngium vesiculosum* Labill.; Hartley Vale; March, 1910 (A. A. Hamilton). Described in the *Flora Australiensis* (Vol. iii., p.370) as having "stems elongated, prostrate, with the appearance of stolons but not rooting." In the specimens exhibited the stems had rooted.—*Opercularia diphylla* Gärtn.; Hartley Vale; March, 1910 (A. A. Hamilton). Not previously recorded from the Blue Mountains.—*Typhonium Brownii* Schott; Stanwell Park; October, 1910 (A. A. Hamilton). Not hitherto known south of Port Jackson.

Mr. E. Cheel exhibited a series of fungi, including—**PUCCINIACEÆ** *Hemileia vastatrix* Berk. & Br. Specimens of Coffee-tree leaves were brought over by Mr. A. R. McCulloch, from Melé, Port Vila, New Hebrides, who reports that the plantations are very badly affected. In the National Herbarium, Sydney, there are specimens from Port Moresby, which were brought over by Burns, Philp & Co. in April, 1903, a fact which clearly proves that the disease has firmly established itself.—**LYCOPERDACEÆ**: *Geaster tenuipes* Berk.; Hobart, Tasm., (S. G. Hannaford; May, 1870); and Byng, near Mount Canoblas, dated July, 1893 (Miss Georgina King). In Cooke's "Handbook of Australian Fungi" (p.227), the only locality recorded for this species is Tasmania. C. G. Lloyd in "The Lycoperdaceæ of Australia, New Zealand and Neighbouring Islands," p.18(1905) mentions that two collections of this species are at Kew, from Tasmania and New South Wales, but he does not give any specific locality; and he is inclined to refer the species to *G. pectinatus*. *Geaster plicatus* Berk.; Tooloom Ranges, Sikes Gap (J. H. Maiden; December, 1907); Rookwood (Miss A. Spencer; July, 1910; communicated by Mr. A. G. Hamilton). Only a solitary specimen of this species was recorded in these Proceedings for 1907 (p.202), so that it is particularly interesting to have more specimens from such widely separated localities. C. G. Lloyd (*op. cit.* pp.17-18) records this species from Sydney, from specimens collected by Mr. R. T. Baker.—**DEMATIACEÆ**: *Helminthosporium Ravenelii* Curt., on the

inflorescence of *Sporobolus indicus* R.Br.; Cheltenham (A. A. Hamilton; May, 1910), and Wahroonga (E. Cheel; September, 1910) near Sydney; previously recorded only from Queensland.

Mr. Fred Turner exhibited and offered observations on *Richea dracophylla* R.Br., a curious and very interesting Epacrid collected on Mount Wellington, Tasmania. Near the summit it grows about five feet high but lower down the slopes it attains a height of twelve feet or more, and at Recherche Bay it is said to develop into a fair-sized tree. The colour of the flowers in the specimen shown was white, but there is a variety with pink flowers though it is said to be uncommon. The allied *Richea gunnii* Hook.f., the only species known to be indigenous to New South Wales, is found on the southern mountains, near Mount Kosciusko; and was first recorded for this State by Mr. Turner in these Proceedings for 1893. This species is also found on the Australian Alps in Victoria, and at high altitudes in Tasmania.

AUSTRALIAN AND TASMANIAN *PSELAPHIDÆ*.

BY ARTHUR M. LEA.

(Plate xxi.)

*Pselaphidæ* are numerous in Australia and Tasmania, and fortunately most of the known species have been well described, or the types are in Australia. So that Australian workers having access to the Australian Museum in Sydney, where, with a few exceptions, the types of King and Macleay are to be found, are much more fortunately placed than with other families, in which so many species have been referred to genera apparently at random, the types lost, or at least their locations unknown, and many of the original descriptions bad or even worthless. Very fortunately also the main worker at the family, M. Raffray, has, in addition to many species described by himself, redescribed many other species, of which he has the types, cotypes, or authenticated specimens, and has beautifully figured many.

Despite the highly distinctive features of many of the genera, the family is a very difficult one to deal with, and in most instances specimens must be set out so that all parts of the under surface and appendages (even the palpi) are clearly visible, and this is by no means easy with such minute insects. Consequently, although much interested in them, it was only with great reluctance that I determined to work out the species of my collection; and had it not been that so many occur in nests of ants and termites, I would not have done so at all, or at least not till after a re-examination of King's and Macleay's types.

For purposes of publication, the species have been divided into two groups, the descriptions of those occurring with ants and termites being sent for publication by the Royal Society of

Victoria, in a paper specially dealing with such inquiline of all families of beetles, the others being given here.\*

So far as the family is concerned, I am, however, rather fortunately placed, having taken numerous species, and often with abundance of individuals, at floods in many parts of Australia, on fence-tops and similar situations at dusk, in nests of ants and termites, and, especially from Tasmania, in mosses, tussocks, and fallen leaves.† Many correspondents have sent me specimens and have even, unsolicited, given me their unique examples. In 1900, M. Raffray published, in these Proceedings, descriptions of many species, the types of which were received from me; and, whilst preparing that paper, he gave me names for many species previously described by himself or other entomologists, many of these names not being mentioned in the paper referred to. Shortly after King's types were acquired by the Australian Museum, I examined the whole of them;‡ and, in exchange for other insects, received many cotypes. At the time, however, I had not paid special attention to the *Pselaphidæ*, although I had many species for comparison with the types, and often from the same or neighbouring localities; and it is probable (in some cases, unfortunately, certain) that specimens appearing in his collection as belonging to but one species, really belonged to two or more. King seldom described the legs, and apparently never examined the ventral segments and metasternum, in which so many remarkable features exist in the males, and which alone quite easily dis-

\* A few species of obscure (probably new) genera, and many females have been left untouched.

† Mosses, tussocks, and fallen leaves have practically been unexamined for *Pselaphidæ* and other small beetles in Queensland, South and West Australia, and very little has been done at them in New South Wales and Victoria.

‡ All families; unfortunately, however, some of the types were represented by labels only, the insects themselves probably having been eaten by *Psocæ* or other vermin, the *Anthicidæ*, perhaps, being the most unfortunate in this respect.

tinguish species that superficially strongly resemble each other.\* In consequence, I obtained and sent to M. Raffray as cotypes, either for his own collection or for examination, a few species of which the correctness of determination is doubtful.† But it is quite certain that such species extremely closely resemble the species they were supposed to be, on the upper surface.

King's types, in fact, need to be carefully examined and redescribed, with especial reference to the under surface and the sexual characters. A few of his types are in the Howitt Collection, and these, by the courtesy of Mr. Jas. A. Kershaw, of the National Museum, I was able to examine and to redescribe. Some of Macleay's species also need redescription.

In descriptions the sex, if possible, should always be noted; and there are but very few species in which the males do not possess some distinctive features in the antennæ, legs, metasternum, or ventral segments.

Many of our species were originally referred to genera that now M. Raffray regards as being entirely absent from Australia, so that generic transfers are frequent, as unfortunately they are in so many other families.

*SAGOLA TASMANIÆ*, n.sp. (Plate xxi, fig.1).

♂. Reddish-castaneous, elytra and legs slightly paler; palpi and tarsi flavous. Clothed with moderately long and somewhat yellowish pubescence.

*Head* rather small; with a deep longitudinal impression. *Eyes* very prominent. *Antennæ* passing base of prothorax, first joint cylindrical, slightly longer than second and third combined, these somewhat rounded, second larger than third, fourth to tenth trapeziform, ninth slightly wider than eighth, tenth slightly

\* I believe it to be impossible to point out distinguishing features in the females of certain species of *Eupines*, *Olenisophus*, and perhaps of a few other genera that will enable coworkers to correctly identify such females, in species that are quite easily distinguished by masculine characters.

† M. Raffray has commented on these.

shorter and wider than ninth, eleventh briefly ovate, distinctly shorter than the two preceding combined. *Prothorax* distinctly wider than head, sides strongly rounded and widest slightly in advance of middle, with a deep narrow impression near base, marked by three foveate expansions, of which the median one is the largest. *Elytra* slightly longer than wide, sides feebly rounded; each with a small fovea at base of subsutural stria, and another slightly behind it; dorsal stria represented by two foveæ—a small one at base, and a longer one behind it; a round fovea at base between dorsal and subsutural striæ; with fairly numerous but rather indistinct punctures. *Abdomen* distinctly longer than elytra, sides slightly dilated to fourth segment, which is largest of all; under surface with a small fovea in middle of third segment, and a considerably larger one common to the fourth and fifth. *Metasternum* strongly convex. *Hind trochanters* strongly but obtusely dentate. Length  $2.2\frac{1}{2}$  mm.

♀. Differs in having the head smaller, antennæ shorter and thinner, abdomen feebly convex along middle of under surface, and hind trochanters unarmed. Length  $1\frac{3}{4}$  mm.

*Hab.*—Tasmania: New Norfolk, Mount Wellington; in moss (A. M. Lea).

I have referred this species to *Sagola*, as it agrees well with Sharp's original diagnosis of that genus\* except that the mesosternum is not elongate, but almost certainly the word "mesosternum" was accidentally used for "metasternum," as Raffray says "Metasternum magnum." The genus is abundantly represented in New Zealand, but is now first recorded from any part of Australia. Of the species figured by Raffray,† it appears to be closest to *S. punctulata*. The only New Zealand species actually known to me is *S. immota*‡ (given by Raffray as a synonym of *S. laminata*) which is somewhat wider, head different

\* I have not, however, dissected out the mouth-parts.

† Rev. d'Ent. 1893, Plate i.

‡ For a specimen of which I am indebted to Major Broun.

between antennæ, medio-basal fovea of prothorax considerably larger, and elytral foveæ somewhat differently placed.

The three apical joints of the antennæ are certainly wider than the others, but the difference is so trifling that the antennæ could fairly be regarded as being without a club. The middle tibiæ are separated by a very narrow keel. The only female before me is probably immature, as it is almost entirely flavous.

LIMONIATES QUADRATIPENNIS, n.sp.

♂. Reddish-castaneous, abdomen (except margins and tip) somewhat darker, appendages paler. Clothed with rather short, pale pubescence, fairly dense but sparser on prothorax than elsewhere.

*Head* distinctly notched in middle of base; with a round fovea near each eye, closed posteriorly but open in front. Antennæ short and stout, second joint subglobular, third to ninth distinctly transverse, tenth larger and widely transverse, eleventh large and briefly ovate. *Prothorax* distinctly wider than head, widest slightly in front of middle; with a strong subbasal impression, somewhat dilated in middle, and on each side expanded into a large and somewhat irregular fovea; a small impression on each side of middle at extreme base; median line very faint. *Elytra* about as long as wide, sides very feebly rounded, angles feebly rounded; with eight minute basal foveæ; dorsal stris traceable only on basal third; with numerous punctures. *Metasternum* deeply notched at apex. *Abdomen* gently flattened about middle, near base, on under surface. *Legs* moderately stout. Length  $1\frac{1}{8}$  mm.

*Hab.*—Tasmania: Hobart, New Norfolk; three specimens from moss (A. M. Lea).

Much larger than *L. australis*, club stouter, and prothoracic impressions rather more distinct.

On one of the specimens the head is slightly darker than the prothorax. The antennæ, at a glance, appear to have the club one-jointed, although the tenth is almost as wide as the eleventh.



**LIMONIATES SUBTERRANEUS King.\***

Pale castaneous, appendages almost flavous. Sparsely pubescent.

*Head* shallowly notched in middle of base, but with a short deep impression starting from its middle; with two distinct foveæ on each side, of which the interocular ones are the larger, the pairs feebly connected longitudinally but not transversely. *Antennæ* scarcely extending to apical third of prothorax, eleventh joint large, briefly ovate, and much wider than tenth, which is transverse. *Prothorax* not much wider than head, widest at about apical third; near base with a strong impression, which is expanded into three foveæ of almost equal size (but not shape), one in middle and one on each side; median line absent. *Elytra* with dorsal striæ deeper and slightly longer, and the punctures less conspicuous, but otherwise as in the preceding species. *Metasternum* rather deeply notched at apex. *Abdomen* feebly flattened along middle of under surface. *Legs* moderately stout. Length  $\frac{4}{5}$  mm.

*Hab.*—New South Wales.

The specimen described is probably a male, and was received from the late Rev. R. L. King's Collection as *Euplectus subterraneus*; and on comparing it with the type it was found to be correctly named, but I cannot find the least trace of a median line in front of the transverse subbasal impression; whereas King says "thorace . . . fovea elongata media antica." It is rather narrower, paler, and more depressed than the preceding species, clothing sparser, less narrowed in front, and impressions both on head and prothorax more distinct.

From some directions, the lateral foveæ of the head appear to form two deep grooves, and, with the medio-basal longitudinal impression, to be very distinct.

\* As King's description of this species is both short and misleading, a fuller one should be of use.

## LIMONIATES VENTRALIS, n.sp.

♂. Reddish-castaneous, elytra slightly paler, appendages distinctly paler, abdomen and metasternum darker, sometimes almost black. With very short, pale pubescence.

*Head* (including mandibles) distinctly transverse; base feebly notched, middle feebly longitudinally ridged; with a shallow depression, but not foveate, on each side of ridge. Antennæ passing middle of prothorax, eleventh joint large, briefly ovate and decidedly wider than tenth, which is distinctly transverse. *Prothorax* feebly transverse, scarcely, if at all, wider than head; with traces of a median line only near base, each side of middle near base with an impressed line dilating towards the side; with numerous and small but fairly distinct punctures. *Elytra* not as long as wide, sides and shoulders rather strongly rounded; with four small basal foveæ; dorsal striæ lightly curved, deep at base and traceable almost to apex; punctures rather more distinct than on prothorax. *Metasternum* strongly sulcate along middle from base to apex. Lower surface of *abdomen* with a longitudinal impression about the length of metasternum, the impression almost filled by a ridge covered with fine golden setæ; apical segment with a feeble fovea. *Legs* moderately long; femora stout; four hind tibiæ spinose at apex. Length  $\frac{3}{4}$ - $\frac{1}{2}$  mm.

♀. Differs in having metasternum feebly impressed and only posteriorly, abdomen simple and tibiæ unarmed.

*Hab.*—W. Australia: Vasse River; numerous specimens in flood-débris (A. M. Lea).

It is with some doubt that this species is referred to *Limoniates*, as the impressions of the head and prothorax are so different from those of the other species known to me; but the curious metasternum and abdomen of the male render the species remarkably distinct.

## MACROPLECTUS QUADRIFOVEATUS, n.sp.

♂. Reddish-castaneous. With rather dense, fine, pale pubescence.

*Head* rather large; with a large fovea on each side of middle

near base, the foveæ rounded and closed posteriorly, but narrowed and continued in front, the interspace distinctly raised. Antennæ with first joint subcylindrical and almost as long as second to fourth combined, second subglobular, distinctly longer than third, third to eighth small and more or less feebly transverse, ninth somewhat larger, tenth slightly larger still, and, with the ninth, subtrapeziform, eleventh elongate-subovate, about as long as eighth to tenth combined. *Prothorax* slightly wider than head, and, excluding the neck, slightly longer, rather strongly dilated towards apex; each side near base with a large fovea, the middle also foveate, the three foveæ connected by curved lines; median line very feeble; with small and rather sparse punctures. *Elytra* almost as long as wide, rather narrow at the base, and dilated posteriorly, apex gently incurved to middle: subsutural stria rather deeply impressed, its base foveate; a fovea on each side marking base of the (otherwise absent) dorsal stria; with fairly numerous punctures. Upper surface of *abdomen* with second segment almost twice as long as third, third distinctly longer than fourth; lower surface with second strongly convex in middle the three following depressed and narrow across middle. *Metasternum* gently flattened in middle. *Legs* unarmed. Length 2 mm.

*Hab.*—Victoria(?)\*

Differs from *M. tasmanicus*, which in general appearance strongly resembles, by the abdomen longer than elytra, with segments very differently proportioned, and the elytral puncture less pronounced. From the description of *M. calcaratus* in the unarmed front tibiae. *M. cephalotes* is described as having a much larger head, etc. The prothorax at first appears to be without median line, but from some directions a rather faint one can be seen.

Three specimens from moss, at Waratah (Tasmania), are probably females of this species; they differ in having the head

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\* The two males before me are probably from Victoria; they were sent from the National Museum as from the Collection of C. French.

slightly smaller, with its impressions smaller, the antennæ shorter, with the club smaller, and the apex of the last joint less produced; and the second ventral segment regularly convex in middle.

*MACROPLECTUS OCTOFOVEATUS*, n.sp.

♂. Reddish-castaneous. With moderately dense, fine, pale pubescence.

*Head* with a round fovea on each side of middle towards base, the foveæ open in front, with the impressions connected between antennæ; the interspace somewhat angular. Antennæ somewhat shorter than in the preceding species. *Prothorax* very little wider than head, and about as long, sides about apex rather strongly inflated; each side near base with a large fovea, from each of which a curved line connects with a medio-basal impression, leaving two basal lobes, each of which has a small fovea; median line narrow and deep at base, but not traceable to middle; punctures very small. *Elytra* about as long as wide, each feebly separately rounded at apex, sides very little dilated posteriorly; subsutural stria very distinct, its base commencing in a small fovea; two small foveæ on each side representing the base of the dorsal stria, and another small one between these and the one close to suture; punctures numerous and small, but distinct. Upper surface of *abdomen* with second segment slightly shorter than third, fourth the length of third, but slightly narrower, and slightly longer and wider than fifth; under surface with third slightly shorter than second, and slightly longer than fourth. *Metasternum* very feebly impressed in middle. Hind *trochanters* obtusely dentate. Length  $1\frac{1}{2}$ - $1\frac{3}{4}$  mm.

♀. Differs in having the antennæ slightly shorter; metasternum not at all depressed in middle, and trochanters unarmed.

*Hab.*—Tasmania: Mount Wellington, Hobart; in moss (A. M. Lea).

In general appearance close to the preceding species, but elytra with eight small basal foveæ (a character which will distinguish it from all previously described species of the genus). The

cephalic foveæ are also smaller, with the result that the interspace is distinctly wider. The antennæ are shorter, with the joints of the male much as in the female of that species, whilst those of the female are still shorter, with the eleventh joint more ovate; the elytra and abdomen are also of different shape.

The place where the transverse and longitudinal impressions of the prothorax cross, whilst very distinct, is scarcely inflated so as to become foveate; from some directions the extreme base appears to have five small foveæ. The dorsal stria from most directions appears to be absent, but from others very vague geminate ones can be seen proceeding for a short distance from the basal foveæ. The apical ventral segment of the male has some curious appendages, but these appear to be protrusible; in the female that segment is flattened at its apex.

*MACROPLECTUS SEXFOVEATUS*, n sp.

Reddish-castaneous, abdomen slightly darker, appendages slightly paler. With rather dense, fine, pale pubescence.

*Head* more convex than usual, but vaguely depressed along middle; each side of middle towards base with a distinct fovea, closed behind but widely and shallowly open in front, the two not connected between antennæ, owing to the antennary tubercles being rather longer than usual. Eyes very small. Antennæ with first joint from some directions appearing not much longer than second, but really almost twice as long, second slightly dilated to apex and distinctly longer than third, third slightly longer than fourth, fourth to eighth very small, ninth slightly larger, the tenth slightly larger still, eleventh subovate, but rather strongly pointed, and about as long as eighth to tenth combined. *Prothorax* slightly transverse, distinctly wider than head, and, excluding the neck, slightly longer; sides dilated near apex; with a deep and almost straight impression close to base, and feebly dilated on each side; median line very feebly impressed; a moderately distinct longitudinal impression on each side, becoming deep near basal impression; with numerous very small punctures. *Elytra* convex, almost as long as wide, sides some-

what inflated in middle, apex almost straight; subsutural stria fairly deep, its base commencing in a small fovea; dorsal stria fine and traceable almost to middle, a small fovea at its base, and another between it and the shoulder; punctures indistinct. Upper surface of *abdomen* with third segment a trifle longer than second or fourth; lower surface feebly flattened in middle, second, third, and fourth segments of about equal length in middle, the fifth very short. Hind *trochanters* obtusely dentate. Length  $1\frac{3}{8}$  mm.

*Hab.*—Tasmania: Mount Wellington; in moss (A. M. Lea).

When viewed from the sides, the head appears to be feebly tuberculate immediately above the subbasal foveæ. The ninth and tenth joints, although larger than the eighth, are still very small, so that the club appears to consist of one joint only, and that not a very large one. The subbasal impressions of the prothorax are very different from those of the two preceding species.

The only specimen before me appears to be a male, as its hind trochanters are armed, but the metasternum is rather strongly convex. The tip of the second ventral segment is minutely emarginate on each side of the middle, in consequence of which the middle itself appears to be slightly produced; but this appearance is very indistinct from most directions.

#### EUPLECTOPS CARINATIFRONS, n.sp.

♂. Reddish-castaneous, appendages and most of elytra somewhat paler. Clothed with distinct, but not very dense, pale pubescence, and with a few longer hairs scattered about.

*Head* with a deep curved impression, each end of which appears as a strong fovea close to each eye, middle of base obtusely notched, space between antennæ raised in the form of a stout, slightly curved carina. Antennæ with two basal joints fairly large, third slightly longer than wide, ninth and tenth moderately large, eleventh subovate, base truncate, apex slightly produced, almost the length of three preceding joints combined. *Prothorax* about as wide as long, widest about middle, sides strongly but evenly rounded to apex but irregularly narrowed to base; with a

deep transverse impression close to base, and distinctly inflated where the longitudinal impressions traverse it; of these the median one is narrow but deep, and not quite continuous to base or apex, and the lateral ones are shorter, deeper, and wider. *Elytra* about as long as wide; base with eight small foveæ; with fairly numerous and small, but distinct, punctures, discal striæ distinct at base, but not very deep elsewhere, and terminated about one-third from apex. Upper surface of *abdomen* with a very feeble medio-basal node, with a very feeble stria on each side of same; lower surface somewhat flattened along middle, and with a shallow impression on apical segment. *Melasternum* rather shallowly impressed along middle. Front *trochanters* obtusely dentate. Length  $1\frac{3}{4}$  mm.

*Hab.*—Tasmania: Frankford (A. M. Lea).

In size and general appearance resembling *E. excisus*, but head differently sculptured, and prothorax rather narrower, with shallower impressions.

From some directions there appear to be two distinct antennary tubercles, but from others the bases of the antennæ are seen to be connected by a distinct curved carina. From some directions the head appears to have three large foveæ of almost even size, and the interocular foveæ to be completely isolated, but from others all the large impressions are seen to be connected. The fifth joint is slightly larger than the fourth or sixth. Owing to the impressions the base of the prothorax appears to be in two distinct lobes.

**EUPLECTOPS CASTOR, n.sp.**

♂. Reddish-castaneous, appendages and most of the elytra somewhat paler. Moderately and almost uniformly clothed with rather long, pale pubescence, and with a few longer hairs scattered about.

*Head* with a strong curved impression, each end of which appears as a strong fovea close to the eye, base obtusely notched in middle, antennary tubercles oblique and rather strong. Antennæ rather short and stout, second joint about as long as

wide, and the width of first, third to eighth small and transverse, ninth larger, tenth trapeziform, eleventh truncate-ovate, apex evenly rounded. *Prothorax* slightly wider than long, sides rather suddenly inflated about middle, impressions somewhat as in preceding species. *Elytra* about as long as wide, distinctly convex, basal foveæ rather shallow, with numerous fairly distinct punctures, dorsal striæ distinct, but not continuous to apex. Upper surface of *abdomen* with medio-basal node and striæ feeble; lower surface flattened along middle. *Metasternum* foveate in middle, and just behind each middle coxa. Front *trochanters* very obtusely dentate. Length  $1\frac{1}{2}$ - $1\frac{1}{2}$  mm.

♀. Differs in having somewhat thinner antennæ, head slightly narrower, with impressions shallower, abdomen more convex along middle of under surface, metasternum with median fovea much less distinct, and the postcoxal ones almost absent.

*Hab.*—Tasmania: Mount Wellington, in moss; Stanley, in tussocks at summit of "Nut"; Launceston, Bruny Island, Huon River (A. M. Lea).

More robust and convex than *E. sculptus*, antennæ shorter and stouter, etc. The prothorax is more convex and rather wider than in the preceding species, and the impressions are rather wider, with the foveate expansions of the basal one larger, but the pubescence somewhat interferes with the clearness of the same, whilst it does not do so in the former.

A male from Mount Wellington has the meso- and metasternum quite black, but it appears to be only a variety.

#### EUPLECTOPS POLLUX, n.sp.

♂. Reddish-castaneous, appendages and most of elytra somewhat paler. Rather densely clothed with short, pale pubescence.

*Head* with a strong curved impression, narrow in front, and each end appearing as a strong fovea close to the eyes, the interspace rather narrow, base obtusely notched, antennæ connected by a distinctly raised, curved carina. Antennæ with second joint rather stout, third slightly longer than wide, fourth to eighth transverse, ninth and tenth somewhat larger,



eleventh briefly truncate-ovate, apex feebly produced. *Prothorax* about as long as wide, widest across apical third, thence strongly narrowed to apex and arcuate to base; with a strong transverse impression close to base; with three deep longitudinal impressions, of which the median one is narrower than the others, and is not quite continuous to apex. *Elytra* about as long as wide, sides moderately rounded; with eight small basal foveæ and with rather small and fairly numerous punctures; dorsal striæ distinct on basal half, but vanishing posteriorly. Upper surface of *abdomen* with medio-basal node feeble, and striæ very indistinct; lower surface slightly flattened along middle. *Metasternum* feebly impressed along middle. Front *trochanters* obtusely dentate. Length  $1\frac{3}{4}$  mm.

♀. Differs in being somewhat thinner, antennæ thinner with the club smaller, cephalic impressions less deep, metasternum and abdomen convex along middle, and trochanters unarmed.

*Hab.*—Tasmania: Mount Wellington, in moss; Launceston (A. M. Lea).

Close to the preceding species, but antennæ slightly thinner, prothorax less strongly impressed, and metasternum different. The head is more deeply impressed than in *E. sculptus*, and the base of prothorax is different.

On the sides there are a few long hairs scattered about, but they appear to be entirely absent from the upper surface. The base of the prothorax appears to be in two lobes, but the sub-basal impression, although somewhat dilated where the longitudinal ones traverse it, is almost straight. On the only male before me, there is a broad flange-like process proceeding from near the base of the fifth ventral segment, and very distinct from the side; it is probably the sheath of the penis.

#### EUPLECTOPS DISCOFALLIDUS, n.sp.

♂. Of a rather pale reddish-castaneous, appendages and most of elytra somewhat paler. Clothed with rather sparse, pale pubescence, interspersed with fairly numerous longer hairs.

*Head* with a deep and strongly curved impression, the ends of which appear as strong interocular foveæ; base obtusely notched; antennæ connected by a curved carina. Antennæ comparatively thin, second joint fairly stout but slightly longer than wide, third to eighth small, ninth and tenth larger and more transverse, eleventh briefly ovate. *Prothorax* about as long as wide, sides strongly and, for the genus, evenly rounded; with a strong transverse impression close to base, and with three longitudinal ones; of these the median one is narrow and rather short, and does not traverse the basal impression; the lateral ones are wider, and each terminates in a shallow, foveate expansion of the basal impression. *Elytra* as in preceding species, except that the dorsal striæ are distinct for a greater distance. Upper surface of *abdomen* with two very short basal carinæ; lower surface slightly flattened along middle. *Metasternum* shallowly impressed posteriorly. *Front trochanters* obtusely armed. Length  $1\frac{1}{2}$ - $1\frac{1}{4}$  mm.

*Hab.*—West Australia: Karridale (A. M. Lea).

In appearance close to *Plectusodes breviceps*, but apical joint stouter, prothorax more convex and narrower, with basal impressions more pronounced and of somewhat different shape. It is fairly close to the description of *Aulaxus rugicollis*, but elytra with more than four basal impressions, metasternum not piceous, and prothorax with the median line almost closed posteriorly. The median line is distinct in front, but narrowed behind, and scarcely visibly connected with the subbasal impression, a character which readily distinguishes it from most species of the allied genera.

The curved impression on the head is comparatively narrow in front, so that from some directions the interspace appears to be actually connected with the frontal carina. The club is rather small, the eleventh joint is no longer than the two preceding combined, and is scarcely produced at apex, but, owing to having rather numerous apical hairs, appears at a glance to be somewhat longer. The medio-basal abdominal node, if present on the types, is entirely concealed.

## EUPLECTOPS CONICICORNIS, n.sp.

♂. Reddish-castaneous, appendages somewhat paler. Moderately densely clothed with pale pubescence, interspersed with numerous longer hairs.

*Head* with a strong curved impression, the ends of which are close to the eyes, base longitudinally impressed, antennary tubercles oblique and distinct. Antennæ with second joint slightly thinner and shorter than first, ninth moderately, tenth more strongly transverse, eleventh as long as the four preceding joints combined, base truncate, apex rather strongly produced. *Prothorax* rather strongly convex; with a straight, deep, and rather wide impression close to base; with three longitudinal ones, of which the median one is narrow and continuous to base, but not to apex; the lateral ones for portion of their length are rather shallow, but each terminates in a foveate expansion of the basal impression; with fairly numerous and small, but quite distinct punctures. *Elytra* rather strongly convex; with eight small basal foveæ; dorsal striæ extending almost to apex, but very indistinct posteriorly; with fairly numerous punctures. Upper surface of *abdomen* with two very short oblique basal carinæ, node apparently absent; lower surface scarcely flattened along middle. *Metasternum* shallowly subfoveate in middle. Front *trochanters* obtusely armed. Length  $1.1\frac{1}{2}$  mm.

♀. Differs in having the club somewhat smaller, cephalic impressions less pronounced, metasternum and abdomen convex along middle, and trochanters unarmed.

*Hab.*—Tasmania: Hobart, in moss; Mount Wellington, in moss and fallen leaves (A. M. Lea).

The antennæ have the terminal joint distinctly longer and more pointed than in *E. Odewahnii*, the clothing is longer, elytra more convex, and legs thinner. It is somewhat smaller than the preceding species, the antennæ more pointed, and clothing longer and denser. In general appearance, except as to size, it is much like *Protoplectus pubescens*.

The median impression on the base of the head is connected with the strong curved one, so that from some directions its basal

parts appear in two almost semicircular lobes. On an occasional specimen the eleventh joint appears as a rather elongated triangle, its apex is strongly produced, in the male especially, and as it is usually terminated by a pencil of hairs, it appears to be considerably longer than it really is. The subsutural striæ are rather less distinct than usual.

EUPLECTOPS BRYOPHILUS, n.sp.

♂. Pale reddish-castaneous, appendages somewhat paler. Moderately densely clothed with rather long, pale pubescence, with a few longer hairs scattered about.

*Head* with a deep curved impression, the ends of which appear as interocular foveæ, base obtusely notched; antennary tubercles fairly large but obtuse. Antennæ as in the preceding species, except that the eleventh joint is rather more pointed. *Prothorax*: somewhat depressed, sides evenly and rather strongly rounded; with a fairly deep and wide impression close to base; with three longitudinal impressions, of which the lateral ones are short and each terminates in a foveate expansion of the basal impression; the median impression is very feeble, and invisible from most directions. *Elytra* moderately convex, rather longer than usual; with eight small basal foveæ; dorsal striæ generally traceable to about middle, but distinct only at base; punctures more or less concealed. *Abdomen* with node absent or concealed; under surface feebly flattened along middle. *Metasternum* shallowly impressed along middle. *Front trochanters* obtusely dentate. Length 1 mm.

♀. Differs in having the antennæ thinner, cephalic impressions less pronounced, metasternum and abdomen rather strongly convex along middle, and trochanters unarmed.

*Hab.*—Tasmania: Waratah, Hobart, New Norfolk; in all cases in moss (A. M. Lea).

In general appearance very close to the preceding species, except that it is smaller, but with the median line scarcely (on some specimens not at all) visible, and terminal joint of antennæ even more pointed. The disc of each elytron, as in most species

of the genus, is somewhat paler than its base, apex, or suture, but the shades of colour are not sharply defined.

The clothing renders the sculpture of the head rather indistinct on some specimens, and on the prothorax more or less obscures the punctures, which appear to be fairly numerous. Five males before me each have a flange-like process much as noted under *E. pollux*.

*EUPLECTOPS ZICZAC*, n.sp.

♂. Reddish-castaneous, disc of each elytron and appendages somewhat paler. Moderately clothed with short pale pubescence.

*Head* with a deep curved impression, the ends of which appear as fairly large and almost closed interocular foveæ, base very obtusely notched in middle; antennæ connected by a slightly curved carina. Antennæ rather short, second joint subglobular, third to eighth very small, ninth and tenth moderately transverse but still small, eleventh briefly ovate, slightly longer than three preceding combined. *Prothorax* depressed, widest at about apical third, thence strongly narrowed to apex and less strongly to base; near base with a strong, angular impression; three longitudinal impressions short, the median one almost round, lateral impressions shallow in front, but foveate posteriorly; with numerous fairly distinct punctures. *Elytra* slightly longer than wide; basal foveæ shallow and indistinct, subsutural striæ much deeper than usual, dorsal striæ very distinct at base, but scarcely traceable to middle; punctures fairly numerous. *Abdomen* with medio-basal node and striæ very indistinct; lower surface scarcely flattened along middle. *Metasternum* shallowly impressed along middle. Length 1 mm.

*Hab.*—Tasmania: Hobart (A. M. Lea).

The small size and comparatively large terminal joint of antennæ, at first appearing to form a one-jointed club, are somewhat suggestive of *Limoniatæ*, but the head and prothorax are not as in that genus. About the size of *E. Odewahnii*, but head and prothoracic impressions, and abdomen of male different.

There are hardly any longer hairs scattered amongst the pubescence. The head is rather larger than usual, and its curved

impression is in parts decidedly narrow. The subbasal impression of the prothorax appears as a v in the middle, with an oblique impression connecting it with each side, so that the raised basal portion appears, from some directions, rather like a reversed W or a broad M, or as two rather wide triangles. The median line appears as a short foveate impression, closed at both ends, but from some directions it appears very indistinctly connected with the basal impression. The fifth ventral segment is gently emarginate at apex, with, beyond this, a rather deep transverse impression; seen directly from behind, this impression appears to consist of two small foveæ. The front trochanters of the type are not clearly visible.

*EUPLECTOPS DEPRESSICOLLIS*, n.sp.

Pale castaneous, disc of each elytron and appendages somewhat paler. Moderately clothed with short, pale, adpressed pubescence.

*Head* with, for the genus, a comparatively shallow curved impression, the ends of which appear as almost circular interocular foveæ, base obtusely notched in middle; antennary tubercles rather feeble. Antennæ rather short, second joint fairly large ninth and tenth moderately large and transverse, eleventh truncate-ovate, about as long as four preceding joints combined, apex distinctly produced. *Prothorax* depressed; near base with a straight transverse impression; median line very feeble, the lateral impressions represented only by slight expansions of the basal impression; with fairly numerous but very small punctures. *Elytra* depressed, slightly longer than wide; with eight small but distinct basal foveæ; dorsal striæ distinct only at base; punctures rather more numerous than on prothorax. *Abdomen* with two very short oblique basal carinæ, node apparently absent; under surface very feebly flattened along middle. *Metasternum* very vaguely impressed in middle. Length 1 mm.

*Hab.*—N. S. Wales: Tamworth, Clarence River (A. M. Lea).

The specimens described were seen by M. Raffray and returned as possibly *Euplectus subterraneus*, but King described the head of that species as "fronte alte transverse foveolato" and pro-

thorax as "fovea elongata media antice." From *E. bryophilus* it differs in being less convex, clothing sparser, antennæ less pointed, and cephalic sculpture shallower.

The cephalic impressions, from some directions, appear as three fairly large, but, for the genus, decidedly shallow, isolated foveæ. The basal impression of the prothorax, although very distinct, is, for the genus, rather shallow; the median line is so faint as to be invisible from some directions. The two specimens described are probably males, but I cannot see the front trochanters of either.

*EUPLECTOPS BASALIS*, n.sp.

Pale castaneous, disc of each elytron and appendages somewhat paler. Moderately clothed with short, pale pubescence, amongst which are scattered a very few longer hairs.

*Head* with a strong curved impression, the ends of which appear as strong interocular foveæ, base obtusely notched; antennæ connected by a curved carina. Antennæ as in the preceding species, except that the apical joint is shorter and much less pointed. *Prothorax*: depressed, with a rather wide and slightly curved subbasal impression, ending on each side in a foveate expansion (these representing all that are left of the lateral impressions); median line very faint; punctures small but numerous and distinct. *Elytra* about as long as wide; with eight small basal foveæ; dorsal striæ scarcely traceable beyond base, punctures fairly distinct. *Abdomen* with a very feeble medio-basal node; under surface feebly flattened along middle. *Metasternum* somewhat flattened along middle. *Hind tibiae* rather wider in middle than usual. Length  $1\frac{1}{2}$  mm.

*Hab.*—Tasmania: Waratah, in moss (A. M. Lea).

Close to the preceding species, but with more distinct punctures, club stouter, tibiae wider, and impressions of head and elytra different. It is less hairy than *E. bryophilus*, with the club shorter and less pointed, etc. The median line of the prothorax is invisible from most directions.

## MESOPLATUS DUBIUS, n.sp.

♂. Reddish-castaneous, elytra slightly paler, appendages still paler. Almost evenly clothed with short white pubescence.

*Head* transverse, base distinctly notched; with two rather shallow foveæ on each side. Antennæ scarcely extending to base of prothorax, second joint fairly large and subglobular, third to eighth short, ninth and tenth larger, distinctly transverse and subequal, eleventh subobpyriform, apex pointed, the length of the three preceding joints combined. Palpi small. *Prothorax* distinctly wider than head, slightly wider than long, widest at apical third, where the sides are strongly rounded, with a wide and rather deep impression near base, traversed by a median and rather feeble impression, but becoming foveate at the impression, each side with a large fovea; punctures partially concealed by clothing. *Elytra* about as long as wide, sides feebly rounded; with eight small basal foveæ; dorsal striæ distinct at base, but terminated before basal third; with moderately distinct punctures. *Metasternum* with a small median fovea and feebly depressed beyond this to hinder apex. *Abdomen* with a small medio-apical tubercle on second segment, the following ones flattened across middle. *Legs* moderately stout; tibiae feebly inflated near apex, the median pair obtusely spurred at apex itself. Length 1-1½ mm.

♀. Differs in having the metasternum scarcely depressed along middle, ventral segments gently convex in middle, and the second without a tubercle, the legs somewhat thinner and the antennæ slightly shorter, with the club smaller.

*Hab.*—W. Australia: Vasse River (A. M. Lea).

In general appearance close to several species of *Euplectops*, but second segment of abdomen of male with a tubercle as in the species of *Mesoplatus*. It is smaller than *M. Edwardsi*, not quite so wide, and head differently impressed. The two foveæ on the front of the head are feebly connected, and also connected with the others (which are slightly in advance of the eyes), but these are not transversely connected; the pubescence, however, somewhat obscures all the impressions.



*BATHISODES INSIGNICOLLIS*, n.sp.

♂. Pale reddish-castaneous. Clothed with rather long, pale pubescence, and with numerous long hairs scattered about.

*Head* with a narrow and almost straight impression close to apex, the impression indistinctly connected on each side with a distinct round fovea close to each eye; forehead feebly impressed along middle. *Antennæ* long and thin, none of the joints transverse, seventh distinctly longer than eighth or sixth, eleventh somewhat shorter than ninth and tenth combined. *Prothorax* slightly transverse, widest at about apical third, thence strongly narrowed to apex and rather less, but still strongly, to base; near base with a strong transverse impression, with a subfoveate expansion in middle and another on each side, disc strongly elevated, with a wide impression on each side of its middle, the same connected with the latero-basal fovea, and irregularly continued across the middle not far from the apex; with an almost closed transverse impression slightly nearer apex than base; with irregularly distributed punctures. *Elytra* with dorsal striae distinct at base and shallowly traceable almost to middle; shoulders unarmed. *Metasternum* rather deeply and widely impressed along middle. *Abdomen* flattened along middle of under surface, apical segment with a feeble apical node. *Trochanters* unarmed. Length 2-2½ mm.

♀. Differs in being slightly less robust, antennæ somewhat thinner, prothorax less inflated near apex, with lateral and basal impressions only, and disc less convex, the cephalic impressions shallower, metasternum very feebly impressed along middle, and abdomen nowhere flattened.

*Hab.*—Victoria (C. French); Wandin (National Museum).

Readily distinguished from all previously described Australian species by the shape of the prothorax. On careful examination all the prothoracic impressions can be seen to be connected, although from most directions the transverse submedian one appears to be closed; immediately in front of this impression the surface from some directions appears to be raised into obtuse

tubercles, almost (from some directions apparently quite) closing the passage of the subapical impression. The space directly behind the impression, from some directions, appears to be transversely oblong.

On this and all the following species there is a more or less conspicuous fringe of long pale hairs on each side of the lower surface of the head, just behind the eyes. They also all have several feeble elevations and depressions at the extreme base of the upper surface of abdomen, but as these are more or less distinct, according to the position of the elytra, it is not considered necessary to describe them.

*BATHISODES TENUCORNIS*, n.sp.

♂. Reddish-castaneous, elytra paler, appendages still paler. With moderately long, pale pubescence, and with a few long hairs scattered about.

*Head* with a shallow impression between antennary tubercles, which are fairly distinct; with a rather large fovea close to each eye, closed behind but shallowly open in front; base feebly notched. *Antennæ* long and thin, none of the joints transverse, third shortest of all, sixth and eighth slightly shorter than fifth and seventh, ninth and tenth rather long, and each not much shorter than eleventh. *Prothorax* about as long as wide, sides strongly rounded in front, and more gently to base; near base with a deep sinuous impression; each side with a deep impression which is narrowed in front and dilated behind, till it irregularly joins in with the subbasal line; near apex with a deep, irregular, transverse impression; disc strongly convex, the middle raised and in the form of an obtuse triangle overhanging the frontal impression; punctures sparse and very irregularly distributed. *Elytra* with dorsal striae deep and distinct at base, but rapidly decreasing in depth, and terminated before middle; shoulders unarmed. *Metasternum* strongly impressed along middle. *Trochanters* unarmed. Length  $1\frac{1}{2}$  mm.

*Hab.*—N. S. Wales: National Park (H. J. Carter).

In general appearance very close to the preceding species, but prothorax with different impressions and when seen directly from

in front with two medio-apical tubercles instead of evenly rounded; seen from the side, there appears an obtuse tooth overhanging the frontal impression, the lateral impression seems to have an isolated granule, and at the base itself there is a small closed fovea.

*BATRISODES GIBBICOLLIS*, n.sp. (Pl. xxi., fig. 2.)

♂. Bright reddish-castaneous, appendages very little paler. With rather long pale pubescence; with sparse and paler long hairs scattered about.

*Head* with antennary tubercles somewhat rounded and prominent, a narrow impression between them; forehead with a narrow longitudinal impression; with a distinct but rather small fovea close to each eye, closed behind but narrowly open in front. Antennæ long and thin. *Prothorax* lightly transverse, sides strongly dilated and with distinct punctures near apex; with a deep, rounded fovea, close to base, and shallowly connected with an irregular impression on each side of base, the irregular impression continued round sides to apex; disc strongly elevated, the elevated portion gradually narrowed to apex, which is truncated or very gently arcuate and overhangs a frontal excavation. *Elytra* with dorsal striæ fairly deep, but terminated before middle; shoulders somewhat raised but unarmed; with fine scattered punctures. *Metasternum* rather shallowly impressed along middle, with a granule between hind coxæ. *Trochanters* unarmed. Length  $2\frac{1}{4}$ - $2\frac{1}{2}$  mm.

*Hab.*—Victoria (National Museum, ex E. Jarvis).

Seen from the side the prothorax appears to be largely excavated in front, with a tubercle overhanging the excavation; a character which will readily distinguish the species from all previously described ones. The antennæ are much as in the preceding species, except that the fifth and seventh joints are slightly longer, and the ninth and tenth slightly shorter.

*BATRISODES APICICOLLIS*, n.sp.

♂. Colour and clothing much as in the preceding species.

*Head* rather convex; antennary tubercles rather small, a narrow impression between them; with a rather large ovate fovea close to each eye, closed behind but open in front; base obtusely notched. *Antennæ* as in *B. tennicornis*. *Prothorax* slightly longer than wide, widest at about apical third, thence strongly narrowed to apex and subarcuate to base; with deep irregular impressions; disc strongly raised. *Elytra* with dorsal striæ distinct only on basal slope, but traceable to basal third; shoulders unarmed. *Metasternum* strongly impressed along middle. *Trochanters* unarmed. Length  $2\frac{1}{2}$  mm.

*Hab.*—N. S. Wales: Illawarra (H. J. Carter).

The prothorax is very irregularly sculptured; near the base there is a deep fovea, from some directions appearing almost round, from others somewhat V-shaped and shallowly and irregularly connected with the sides. On each side of the base there is a small isolated fovea, and two suboblique impressions close together and connected at their apices. The dilated sides about the apex have distinct punctures, and are separated from the disc by deep lines. The disc is strongly raised and is triangularly pointed in front (a character which will readily distinguish it from the preceding species), the point being level with the middle of the dilated lateral parts; the whole of the space in front, and at the sides of it, is largely and irregularly impressed, but the impressions are somewhat obscured by the clothing.

#### BATRISODES PUNCTIFRONS, n.sp.

♂. Colour and clothing much as in *B. gibbicollis*.

*Head* moderately convex; antennary tubercles rather small, a shallow impression between them; forehead with a distinct median line; with a small round fovea close to each eye, closed behind, but narrowly open in front. *Antennæ* as in *B. gibbicollis*. *Prothorax* about as wide as long, widest at about one-third from apex, thence strongly rounded to apex and more gradually narrowed to base; with a fairly deep fovea close to base, and irregularly and shallowly connected with sides, which are also irregularly foveate; a shallow impression on each side marking off the

dilated parts (which are densely punctured in front) from the disc; disc convex, with the convex part gradually narrowed in front, and at apex truncated. *Elytra* with dorsal striae fairly deep about base, and traceable almost to middle; shoulders unarmed and somewhat narrower than usual. *Metasternum* shallowly impressed along middle; with a small granule between hind coxæ. *Trochanters* unarmed. Length  $2\frac{1}{2}$  mm.

*Hab.*—N. S. Wales: Illawarra (H. J. Carter).

The prothorax is somewhat as in *B. gibbicollis*, but the apex as seen from the sides is much less excavated, with the disc less strongly raised and its apex not overhanging; the lines marking off the dilated sides are also much shallower, with the dilated parts themselves punctured only in front. It is also a somewhat narrower species.

BATRISODES KERSHAWI, n.sp.

♂. Reddish-castaneous, elytra and appendages slightly paler. Clothed with rather long pale pubescence.

*Head* rather more convex and with smaller eyes than usual; antennary tubercles rather large and obtuse, the space between them depressed but without a sutural line; forehead with a narrow median carina; a rather short curved impression on each side, ending in a slight foveate expansion close to the eye. Antennæ long and rather thin, third joint slightly longer than second, fifth and sixth each slightly longer than seventh, eighth shortest of all, ninth the length of sixth, tenth slightly shorter, eleventh somewhat shorter than ninth and tenth combined. *Prothorax* less convex than usual, slightly longer than wide, sides strongly rounded and strongly lessened to apex, and less strongly to base; near base with a fovea irregularly connected with latero-basal impressions; each side with a deep impression appearing to terminate suddenly about the middle, but really very feebly connected with the apex. *Elytra* rather wider and less convex than usual; dorsal striae traceable only on basal slope; shoulders unarmed. *Metasternum* widely impressed along middle, the impression rather shallow at base, but becoming deeper in middle posteriorly. Hind *trochanters* strongly dentate. Length  $2\frac{1}{2}$  mm.

*Hab.*—Victoria: Emerald, in damp places (National Museum ex E. Jarvis).

In general appearance rather close to *B. tibialis*, but larger and stouter, head not quite the same, dorsal striæ much shorter, tibiae simple, etc. The head is somewhat as in *B. bimucronatus*, but the prothorax is without the conspicuous median channel of that species.

The pubescence is rather long, but on the two specimens before me there are no long hairs scattered about. The medio-basal impression on the prothorax from some directions appears in the form of a narrow deep isolated line, from others it appears fairly large and rounded, with a feeble subtubercular elevation on each side of it, the tubercles being quite distinct from the sides; the lateral impressions from some directions appear rather deep, but from others each appears as an almost rounded and isolated fovea.

#### EUPINES.

The males of this genus usually have very distinctive features in the metasternum and abdomen, and often in the legs and antennæ, but the females seldom possess such. I think that no species of the genus should be described from the female only, although this has been done in many instances, with the probability of causing confusion.

It is not always easy to mount single and small (such as all species of this genus are) specimens, so that both the under and upper surfaces can be examined, but it is absolutely necessary to do this in *Eupines*, as many species strikingly alike on the upper surface, even in such an abnormal feature as a strongly inflated fifth antennal joint, are quite readily distinguished by the metasternum and abdomen. The front trochanters of the males are also frequently armed, but the armature is not always easy to see, even on specimens mounted on their backs. The second abdominal segment appears to be the first, the true first nearly always being almost or quite concealed.

Of some of the species of which only the male is here described, I probably have the female, but not being certain that they are correctly mated, I refrain from describing the latter sex.

## EUPINES QUINTANA, n.sp.

♂. Piceous-brown, elytra bright reddish-castaneous, legs and antennæ somewhat paler, but club slightly darker. With rather long, pale, straggling, sparse hairs.

*Head* with a minute puncture close to each eye, and a very shallow depression behind base of each antenna. Antennæ with fifth joint inflated, and angularly produced at its inner apex, ninth slightly transverse and feebly produced inwardly, tenth more transverse and also feebly produced inwardly, eleventh rather large and ovate. *Prothorax* widest at about one-third from apex. *Elytra* with a faint impression on each side of base, representing the dorsal striæ. *Metasternum* rather narrowly and deeply grooved. Second segment of *abdomen* with a small flattened suboblong median node, rather nearer its base than its apex, apical segment flattened in middle. *Front trochanters* finely and acutely dentate. Length 1 mm.

♀. Differs in having the fifth joint of antennæ scarcely stouter (although slightly longer) than fourth or sixth, the club smaller, metasternum faintly impressed and only at apex and abdomen, and trochanters simple.

*Hab.*—Tasmania: Jordan River, Launceston, Stonor, Swansea, Hobart (A. M. Lea).

Differs from *E. globulifera* in having the antennæ of both sexes longer, metasternum of male apparently strongly carinate\* on each side of sulcus and not tuberculate posteriorly. *E. nigriceps* is smaller and differently coloured, with tenth joint of antennæ, and metasternum different. *E. nigricollis* is larger, with two distinct punctures or small foveæ between eyes. *E. biclavata* is very differently coloured, with abdomen of male different. *E. sobrina* (from Tasmania) is described as castaneous, with the elytral disc paler. *E. vitrea* (also from Tasmania) is described as differently coloured, and the sutural stria scarcely impressed.

Most of the specimens before me have the prothorax as dark as the head, but on some it is not so dark, although never so pale

\* This appearance is due to the rather precipitate sides of the sulcus, and not to any elevation of the surface itself.

as the elytra; the latter occasionally have the suture feebly infuscated. The ninth and tenth joints are slightly darker than the eleventh. The clothing on some specimens is very distinct, but appears to be easily abraded.

Two specimens before me (sexes) are entirely pale, but this is probably from immaturity. In appearance they are remarkably close to *E. sulcata*, but the second ventral segment has a much shorter tubercle.

EUPINUS DISTORTICORNIS, n.sp.

♂. Dull reddish-castaneous, legs somewhat paler, club slightly darker.

*Head* rather more transverse than usual, with a shallow impression close to each eye, and a somewhat larger but shallower impression behind each antenna. Antennæ with fifth joint inflated and angularly produced at inner apex, ninth moderately transverse and somewhat produced on one side, tenth larger than ninth, one side of apex somewhat produced, the other excavated, eleventh fairly large, with the inner base strongly produced backwards. *Prothorax* widest at about one-third from apex. *Elytra* rather more strongly dilated posteriorly than usual, dorsal striæ traceable at extreme base only. *Metasternum* widely and shallowly impressed along middle. *Abdomen* with second segment impressed along middle. Length 1 mm.

♀. Differs in having fifth joint of antennæ simple, metasternum not impressed along middle, and abdomen simple.

*Hab.*—W. Australia: Vasse, Boyanup (A. M. Lea).

In many respects close to Raffray's description of *E. diversicolor*, but the antennæ differ from Raffray's figure in the ninth joint being much less produced, and the eleventh strongly produced obliquely backwards on one side; the fifth is produced on one side also. From the original description it differs in several respects in colour. The shapes of the joints of the club readily distinguish it from all other species having the fifth joint inflated.

The upper surface at first appears to be quite glabrous, but on careful examination a few pale hairs are to be seen. The



abdominal impression from some directions appears to be supplied with a minute tubercle on each side of its apex. The legs of the male appear to have no distinctive features, but I cannot examine the trochanters of the type.

**EUPINES TUBERCULIFERA, n.sp.**

♂. Bright reddish-castaneous, legs and tip of abdomen paler, head much darker, fifth and ninth and tenth joints of antennæ lightly infuscated. Upper surface with distinct and rather long pale hairs.

*Head* with a shallow impression close to each eye, and a still more shallow one on each side in front. *Antennæ* with fifth joint moderately inflated, ninth and tenth somewhat produced on one side, eleventh ovate. *Prothorax* widest at about one-third from apex. *Elytra* with sides rounded, but apex very little wider than base, dorsal striæ traceable only on basal slope. *Metasternum* distinctly impressed posteriorly. *Abdomen* with a conspicuous, subconical, medio-apical tubercle on second segment. *Front trochanters* each with a long acute spine. Length 1 mm.

*Hab.*—New South Wales: Sydney (H. J. Carter).

In other species the interocular impressions, when present, are round and perfect, although often shallow; in the present species, however, they open out towards the sides, so that from some directions they appear to be semicircular, with the inner side of each convex. The fifth joint of the antennæ, although distinctly inflated, is rather smaller than in other species having it large.

Agrees fairly well with the original description of *E. pumilio*, but Raffray notes that species as having the second ventral segment with a fine longitudinal carinule extending beyond the middle, and the forehead with transverse impressions. There are several of Schaufuss's species with the fifth joint inflated, about which information as to the ventral characters is still required, but Raffray has fortunately described such for most of the former's species.

**EUPINES OBLONGIFERA, n.sp.**

♂. Colours as in the preceding species. Upper surface with sparse, straggling, pale hairs, becoming rather conspicuous on abdomen.

*Head* with four shallow impressions. *Antennæ* with fifth joint inflated and produced on one side of apex, ninth about as long as wide, tenth rather strongly transverse, eleventh ovate. *Prothorax* widest at about apical third, and rather more strongly narrowed to base than usual. *Elytra* comparatively large, apex distinctly wider than base; dorsal striae traceable at extreme base only. *Metasternum* rather strongly impressed along middle. *Abdomen* with an oblong tubercle on second segment, the tubercle surrounded by a narrow impression. *Front trochanters* feebly and obtusely dentate. Length  $1\frac{1}{2}$  mm.

*Hab.*—New South Wales: Sydney (H. J. Carter).

In general appearance close to *E. quintana*, but abdominal tubercle completely isolated by a narrow impression (somewhat as on the prothorax of *Bothrideres Mastersi*), although from some directions it is not very distinct. The front trochanters are also not acutely dentate, the fifth joint is smaller, and the metasternal impression is shallower and more dilated posteriorly. The only male before me was sent mounted on the same card with two males of the preceding species, and in fact it bears a quite extraordinary resemblance to it, but the very different second segment of abdomen, and front trochanters, readily distinguish the two species. A female mounted and sent on the same card may belong to either species; its abdomen and trochanters are simple, and the fifth joint of antennæ is not inflated.

#### EUPINES MIRA, n.sp.

♂. Bright reddish-castaneous, legs and eleventh joint of antennæ paler, rest of antennæ, except basal joints, darker. Upper surface with very sparse, and rather short, pale hairs.

*Head* scarcely visibly impressed close to each eye, and impressions behind antennæ very faint. *Antennæ* rather long; first to seventh joints each longer than wide, eighth small, about as long as wide, ninth moderately, tenth strongly transverse, eleventh briefly ovate. *Prothorax* comparatively short, widest at about two-fifths from apex. *Elytra* moderately dilated posteriorly, dorsal striae traceable only at and about base. *Metasternum*

largely excavated along middle, each side of the excavation near the apex with a small acutely conical tubercle. *Abdomen* widely flattened along middle, apical segment shallowly depressed. *Front trochanters* acutely dentate; front tibiæ gradually dilated from base to beyond the middle, and then suddenly narrowed to apex; hind tibiæ strongly and acutely dentate near apex, with the apical half somewhat inflated. Length 1 mm.

♀ Differs in having legs and abdomen simple, and metasternum unarmed and more shallowly impressed along middle.

*Hab.*—W. Australia: Swan River, at lights; Vasse River, in flood-débris (A. M. Lea).

The combination of conspicuously pale terminal joint of antennæ, curious front and hind tibiæ, with the armed metasternum of the male, readily distinguish it from all previously described species.

The interocular impressions are so faint and minute that it is only with great difficulty that they can be seen at all. The metasternal tubercles are very distinct from the sides, and are placed immediately behind the hind coxæ. There are 29 females before me, but only six males.

#### EUPINUS LITORALIS, n.sp.

♂. Rather pale castaneous. Clothed with very short, depressed pubescence.

*Head* rather more transverse, and with rather larger eyes than usual, interocular impressions very small and faint, frontal ones almost or quite absent. *Antennæ* short, first and second joints moderately large, third to ninth very small, tenth large and moderately transverse, eleventh briefly ovate. *Prothorax* shorter than usual, widest almost at extreme apex. *Elytra* conjointly gently arcuate at base, sides moderately dilated posteriorly; dorsal striæ entirely absent. *Metasternum* very widely and shallowly impressed along middle. Second segment of *abdomen* with a minute median tubercle. *Trochanters* unarmed. Length 1 mm. (vix).

♀. Differs in having tenth joint of antennæ much, and the eleventh slightly smaller; metasternum shallowly impressed and only between hind coxæ, and abdomen non-tuberculate.

*Hab.*—New South Wales: Clifton (A. M. Lea).

In general appearance close to *E. exigua*, but elytra very finely pubescent, and at base with an even curvature not at all interrupted by remnants of dorsal striæ; and the metasternum and abdomen different. *E. capitata*, which it much resembles, has distinct cephalic impressions, and elytra with remnants of dorsal striæ. *E. lævifrons* is shining, and also with remnants of dorsal striæ. *E. concolor* is described as having a large fovea on the apical segment.

The front and middle tibiæ of the male are slightly dilated at apex, but the inflation is not conspicuous; occasionally, however, owing to the clogging of some hairs near the apex of the middle pair, these appear to be rather strongly inflated. The club is conspicuously two-jointed. The fine pubescence causes the derm to appear subopaque. Numerous specimens were taken on a beach, under stones, just above high-water mark.

#### EUPINES CARTERI, n.sp.

♂. Pale castaneous, appendages somewhat paler, except club, which is slightly darker. Clothed with very fine, depressed pubescence.

*Head* with interocular impressions small but fairly distinct, and frontal ones very shallow. *Antennæ* short. *Prothorax* rather shorter than usual. *Elytra* with a vague impression close to each shoulder, representing the dorsal striæ. *Metasternum* widely and shallowly impressed along middle. *Abdomen* with a small but distinct tubercle in middle of second segment. *Trochanters* unarmed. Length  $\frac{1}{4}$  mm.

*Hab.*—New South Wales: Gosford, in moss (H. J. Carter).

In general appearance very close to *E. capitata*, but male with eleventh joint of antennæ larger and tenth smaller, tubercle of abdomen without a depression behind it when viewed from any direction, and metasternum more excavated along middle. Also

close in appearance to *E. exigua* (the club of which is as in the male of *E. capitata*), but elytral pubescence denser and finer, and prothorax rather wider at base. Also very close to the preceding, and with pubescence almost the same, although not quite so short, but the metasternal excavation is rather shallower, prothorax wider at base and a trifle shorter, and elytra with vague remnants of dorsal striæ. The antennæ at first appear much the same, but the tenth joint is shorter and so more transverse, and the eleventh is even more briefly ovate; the ninth joint is somewhat larger, so that the club should perhaps be regarded as three-jointed instead of two-jointed.

*EUPINKS BITUBERCULATA*, n.sp.

♂. Bright reddish-castaneous, appendages somewhat paler, head generally much darker, suture lightly infuscated. Upper surface glabrous.

*Head* without interocular impressions, and the frontal ones very shallow and indistinct. Antennæ rather long, ninth joint feebly transverse, tenth fairly large but very feebly transverse, eleventh ovate. *Prothorax* fairly long and strongly convex, widest at about apical fourth. *Elytra* rather large and dilated posteriorly although not to apex; subsutural striæ comparatively feeble, the dorsal ones entirely absent. *Metasternum* rather widely and shallowly impressed. *Abdomen* with two conspicuous tubercles close together at apex of second segment, and slightly overhanging the third. *Trochanters* apparently unarmed; front tibiæ moderately dilated at apical third, and then narrowed to apex. Length  $1.1\frac{1}{2}$  mm.

♀. Differs in having the metasternum much more shallowly impressed, the abdominal tubercles absent, and front tibiæ simple.

*Hab.*—New South Wales: Sydney, seven specimens in grass tussocks (A. M. Lea).

The sexual characters are much as described by Raffray for *E. melanocephala*, but the types are from Sydney, and the abdomen in all of them is no darker than the elytra; Schaufuss described

the head and abdomen as piceous-black, and the type as from Tasmania.

Some of the specimens have the head no darker than the prothorax, but on others it is almost black. The dilatation of the front tibiae, although distinct, is much less so than in several other species, and has hardly a trace of a dentate appearance.

#### EUPINES HELENÆ, n.sp.

♂. Dark piceous-brown, legs and palpi of a rather dingy castaneous. Upper surface (except of abdomen, which is very finely pubescent) glabrous.

*Head* with a small but rather deep puncture close to each eye; frontal impressions absent. *Antennæ* rather short, second joint slightly longer than wide, third to ninth short, tenth large, feebly transverse, eleventh ovate, slightly smaller than tenth. *Prothorax* rather short, widest quite close to apex. *Elytra* about as long as wide, apex very little wider than base; without traces of dorsal striæ. *Metasternum* rather vaguely impressed along middle. *Abdomen* with a fairly distinct impression along middle of second segment. *Front trochanters* somewhat obtusely dentate. Length  $\frac{1}{2}$  mm.

*Hab.*—Tasmania: Huon River, in tussocks; Hobart, in moss (A. M. Lea).

More elongate than *E. nigra*, and tenth joint of antennæ considerably larger, with metasternum much less impressed along middle.

One of the specimens before me is almost black, another is of a rather dark reddish-brown. The tenth joint is slightly shorter than the eleventh, but its bulk is slightly more. I have named this species after my eldest daughter, whose quick eyes have frequently been of assistance to me, when examining sievings from mosses and tussocks for insects.

#### EUPINES NIGRICLAVA, n.sp.

♂. Blackish-brown, elytra dark reddish-brown, legs somewhat paler; antennæ slightly darker than legs, but club distinctly darker. Clothing as in the preceding species.

*Head* with interocular impressions very minute and frontal ones very faint. *Antennæ* with second joint fairly large, tenth transverse, and not half the length of eleventh, which is ovate. *Prothorax* and *elytra* much as in the preceding species, except that the latter are rather more dilated posteriorly. *Metasternum* widely and rather shallowly impressed. *Abdomen* with two small tubercles close together near apex of second segment; apical segment with a round, shallow fovea. *Front tibiæ* rather strongly inflated to beyond the middle, the inflation ending in a strong subtriangular tooth, thence emarginate to apex. Length 1 mm. (vix).

♀. Differs in having the club slightly smaller, metasternum convex, abdomen without tubercles or fovea, and front tibiæ simple.

*Hab.*—Tasmania: Frankford (A. M. Lea).

In general appearance very close to the preceding species, but the tenth joint of male very much smaller than eleventh; and the front tibiæ armed; the latter character will also distinguish it from *E. nigra*. I have not been able to see clearly the front trochanters of the only male before me.

#### EUPINES MODICA, n.sp.

♂. Dark reddish-brown, or piceous-brown, elytra not much paler, legs and eleventh joint of antennæ still paler, but not very pale. Elytra scarcely visibly pubescent, the abdomen with very minute, but rather more noticeable clothing.

*Head* with interocular and frontal impressions absent or extremely faint. *Antennæ* with second joint scarcely longer than wide, third to ninth short, tenth rather strongly transverse, eleventh briefly ovate. *Prothorax* and *elytra* as in the preceding species. *Metasternum* semicircularly impressed beyond the middle. *Abdomen* with two very minute granules or fascioles near apex of second segment, between which a very faint impression can be seen from some directions. *Trochanters* apparently unarmed. Length 1-1½ mm.

♀. Differs in having antennæ somewhat shorter, with the club smaller, metasternum impressed only between hind coxæ, and abdomen without granules or longitudinal impression.

*Hab.*—New South Wales: Ourimbah, in moss; Forest Reefs—Tasmania: Huon River (A. M. Lea).

From *E. nigra* distinguished by the very feeble impression on metasternum and much smaller abdominal granules; from *E. Helena* by the different tenth joint of antennæ; from *E. nigriclava* by the unarmed tibiæ; and from *E. bicolor* by the shorter antennæ and very different abdomen.

#### EUPINEX INDISTINCTA, n.sp.

♂. Dark piceous-brown, elytra somewhat paler, appendages still paler, but not very pale. Upper surface glabrous, except of abdomen, which is very finely pubescent.

*Head* with interocular impressions absent, and frontal ones extremely faint. *Antennæ* with second joint subglobular, third to ninth short, tenth fairly large and transverse, eleventh briefly ovate. *Prothorax* and *elytra* as in the two preceding species. *Metasternum* rather widely and shallowly impressed. *Abdomen* with a feeble impression on second segment. *Front trochanters* very obtusely dentate. Length 1 mm.

*Hab.*—Tasmania: Launceston, in tussocks; Huon River, Hobart (A. M. Lea).

Distinguished from the three preceding species, and from *E. bicolor*, by the basal segment of the abdomen, which has a minute median impression marking the apex of a feeble triangular depression, the base of which is at the apex of the segment. Both impression and depression are extremely feeble, however, and both can usually not be seen at the same time. From some directions the median depression appears as a minute tubercle. The tenth joint of antennæ is distinctly larger than in either of the two preceding species, but is smaller than in *E. Helena*.

Some specimens, which are probably females of the species, differ from the males in being slightly smaller, antennæ shorter with tenth joint much smaller, metasternum impressed only



between the hind coxæ, abdomen without impression and trochanters edentate.

EUPINES TIBIALIS, n.sp.

♂. Colour and clothing as in the preceding species, except that the club is darker.

*Head* without visible interocular or frontal impressions. *Antennæ* with second joint fairly large, tenth moderately large and transverse, eleventh ovate. *Prothorax* and *elytra* as in the three preceding species, except that the latter are rather more dilated posteriorly. *Metasternum* largely impressed along middle, and with an obtuse tubercle behind each hind coxa. *Abdomen* with a fairly large impression on second segment, the impression dilated posteriorly, and at each side of its apex with an obtuse tubercle; apical segment with a distinct but rather shallow impression. *Front trochanters* obtusely dentate; *front tibiæ* somewhat inflated near apex, and thence suddenly lessened to apex itself. Length  $1\frac{1}{2}$  mm.

*Hab.*—New South Wales: Wollongong (A. M. Lea).

In general appearance very close to *E. nigriclava*, but antennæ with tenth joint larger; *front tibiæ* thickened near apex but not obtusely dentate; and abdomen and metasternum somewhat different. The tenth joint is almost as large as in the preceding species. It is also very close to *E. nigra*, but *front tibiæ* considerably stouter, excavation of basal segment more pronounced, with its marginal tubercles more conspicuous. In *E. Helenæ* the sides of the *elytra* are somewhat rounded, but lines drawn from the shoulders to the apices would be parallel to each other; in the three preceding species such lines would be somewhat divergent, and in the present species still more noticeably so.

EUPINES INERMIS, n.sp.

♂. Of a rather dark reddish-brown, upper surface of head and of abdomen somewhat darker, legs and two apical joints of antennæ rather pale castaneous. Upper surface with very sparse, straggling hairs.

*Head* without interocular impressions, the frontal ones feeble but fairly distinct. *Antennæ* comparatively long, second joint fairly large, third to eighth each slightly longer than wide, ninth subglobular, tenth moderately transverse and rather small, eleventh ovate. *Prothorax* moderately long, widest at about apical third. *Elytra* slightly longer than wide, shoulders strongly rounded, a vague depression within each shoulder representing remnants of dorsal striæ. *Metasternum* rather strongly impressed, the impression dilated posteriorly. *Abdomen* with a feeble longitudinal impression extending, with interruptions, to apex. *Legs* unarmed. Length 1 mm.

*Hab.*—New South Wales: Sydney (A. M. Lea).

In general appearance close to *E. pallipes*, but without a conspicuous puncture near each eye, antennæ differently coloured, and apex of abdomen not paler than the base. *E. mira*, which has the terminal joint of antennæ pale, is otherwise coloured, and has four of the tibiæ armed in the male.

#### EUPINES RECURVA, n.sp.

♂. Of a rather bright pale castaneous; appendages somewhat paler. Upper surface glabrous, except of abdomen, which is finely pubescent.

*Head* without interocular impressions, and frontal ones rather faint. *Antennæ* with second joint rather large, tenth rather small and feebly transverse, eleventh ovate. *Prothorax* rather short, widest quite close to apex. *Elytra* rather strongly dilated posteriorly and much wider at apex than at base; dorsal striæ very faintly traceable, and only at extreme base. *Metasternum* shallowly impressed. *Abdomen* with a slightly raised and curved carina at apex of second segment, the convex side of the carina directed towards base, apical segment with a large curved impression. Front and hind *trochanters* obtusely dentate; front tibiæ dilated to beyond the middle, and thence emarginate to apex. Length 1 mm.

*Hab.*—New South Wales: Nepean River (A. J. Coates).

In some respects close to *E. tuberosa*, but head and club not infuscated, and carina or tubercle of abdomen at extreme apex

of its segment, instead of close thereto. Also close in appearance to *E. aurora*, but smaller, second segment of abdomen not subopaque, its tubercle of different shape, and apical one without two setæ directed forwards. From some directions the front tibiæ appear conspicuously dentate.

EUPINKS TARSALIS, n.sp.

♂. Reddish-castaneous, elytra and appendages somewhat paler. With comparatively dense and somewhat golden pubescence, rather sparser on prothorax than elsewhere.

*Head* with two small but fairly deep and conspicuous interocular foveæ; frontal impressions small but fairly distinct. *Antennæ* fairly stout, second joint very little longer than third, second to fourth subglobular, fifth somewhat longer and more cylindrical, sixth and seventh moderately, the eighth more strongly transverse, ninth fairly large, acutely produced at outer apex, tenth larger and of somewhat irregular shape, eleventh slightly larger than tenth and briefly ovate. *Prothorax* rather short, widest at about apical third, with minute but traceable punctures. *Elytra* slightly longer than wide, dorsal striæ deep at base and distinct to middle of disc; with fairly dense and quite distinct punctures. *Metasternum* rather widely and deeply impressed along middle. *Abdomen* with a small but conspicuous medio-apical fascicle on second segment, apical segment very shallowly impressed. *Trochanters* apparently edentate; femora and front tibiæ rather stout; hind tarsi with basal joint minute, second large, about one-third the length of tibia and inflated to one side of apex, apical joint fairly large but partially concealed by second; middle tarsi with first joint small but larger than on the hind pair, second large, but not much larger than third, and much smaller than the second of the hind tarsi; front tarsi with first joint small and the second larger but not longer than third; each terminated by a single claw. Length  $1\frac{1}{2}$  mm.

♀. Differs in having the club with smaller and simple joints, metasternum convex along middle, abdomen non-fasciculate, and hind tarsi with second joint shorter and not produced at one side of apex.

*Hab.*—Tasmania: Mount Wellington, Waratah, in moss (A. M. Lea).

The hind tarsi are very peculiar, and had the species been before M. Raffray it is possible that he would have referred it to a new genus. It is unusually large for *Eupines*, and with the dorsal striae and elytral punctures quite distinct. The under surface of the tenth joint appears to have a feeble fascicle at its apex, and from certain directions this causes it to appear feebly tuberculate.

*EUPINES CAPITATA* King.

A male of this species from the late Rev. R. L. King's Collection is before me. Its metasternum is widely and rather shallowly sulcate. Basal segment of abdomen with a feeble median node (from some directions this appears to be semidouble and marking the apex of a very short and feeble longitudinal impression) immediately behind which is a feeble transverse impression at the apex, but invisible from certain directions. The apical segment is widely and rather feebly impressed. In addition to the transverse impression on the head, mentioned by King, there is a very feeble rounded impression towards each side. The upper surface is clothed with very fine pubescence.

*EUPINES BICLAVATA* Raffr.

A specimen of this species, from the Victorian Alps, is in the National Museum, Melbourne.

*EUPINES SULCATA* Sharp.

The male of this species is readily known by the inflated fifth joint of antennæ, which is obtusely produced to one side, and by the conspicuous median carina on the under surface of the abdomen.

*Hab.*—W.A.: Swan River, Beverley—Queensland: Dalby—New South Wales: Sydney.

*EUPINES LATICLAVA* Schauf. (*Bryaxis*).

A specimen\* before me, from the Clarence River, in New South Wales (the type was described as from Tasmania) probably

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\* It was sent to M. Raffray some years back, but returned without comment, although his attention was specially drawn to it.

belongs to this species. Schaufuss described the antennæ as "*10-articulatis, articulis 8-10 valde clavatis, nono latiore.*" The Clarence River specimen, from above, certainly appears to have but 10 joints, with the ninth widest; but from below the supposed ninth joint is seen to be really the tenth, the true ninth being small, and projecting to one side, but not sufficiently so to be seen from above; the eighth is large and strongly transverse, tenth largest and widest of all, sides rounded, one side of base emarginate and produced, the other feebly emarginate and not produced, eleventh briefly obpyriform.

From above, the eighth appears larger than from below, the true tenth appears larger at one end than the other, but scarcely emarginate; the others appear as from below.

The specimen is a male, with the metasternum gently concave and with a minute tubercle on each side of middle of apex; and second segment of abdomen, on its under surface, with a flat feeble medio-basal elevation, appearing semidouble from some directions.

*RYBAXIS PARVIDENS*, n.sp.

♂. Dark reddish-castaneous; legs slightly paler, elytra bright castaneous, but suture darker, tenth joint of antennæ piceous, the eleventh palest of all. With short pale pubescence, more noticeable on abdomen than elsewhere.

*Head* with two large, closed, interocular foveæ, and a fairly large interantennal impression. Antennæ with first joint fairly large and subcylindrical, second subglobular, fifth distinctly longer than fourth or sixth, seventh and eighth short and subtriangularly produced on one side, ninth larger and very obtusely produced on one side, tenth rather large and subtrapeziform, eleventh ovate, not as long as the two preceding combined. *Prothorax* widest at about apical third, sides strongly rounded, with a large fovea on each side near base, with a deep curved impression connecting them, the impression but slightly expanded in middle. *Elytra* rather large; dorsal striae distinct, somewhat curved and vanishing

close to apex, with irregularly distributed punctures; epipleural furrow deep, lightly curved and terminated at about one-fifth from base and apex. Upper surface of *abdomen* with a small medio-basal node, on each side of which is an extremely short stria; lower surface somewhat flattened in middle. *Metasternum* widely flattened or very gently concave in middle; on each side, just behind hind coxæ, with a fairly large subconical tubercle. Front *tibiæ* lightly curved; very feebly dentate slightly nearer base than apex. Length  $1\frac{1}{2}$ - $2\frac{1}{4}$  mm.

♀. Differs in having thinner antennæ, with none of the joints produced inwards, and the eleventh as long as the ninth and tenth combined; the abdomen is convex on its under surface, and the metasternum and legs are unarmed.

*Hab.*—Tasmania: Hobart, Mount Wellington, Long Bay; in moss (A. M. Lea).

In many respects close to *E. quadriceps*, but smaller, darker, and front *tibiæ* more curved and almost simple, instead of with a conspicuous median tooth or emargination, and with the ninth joint as well as the seventh and eighth produced to one side. From *E. adumbrata* it differs in the front *tibiæ* with the tooth nearer the base, body more robust, and metasternum with a conspicuous subapical tubercle on each side.

Some specimens have the abdomen almost piceous. The ninth joint of antennæ is sometimes almost as dark as the tenth. From some directions the seventh and eighth joints of the male appear to be quite acutely produced inwards, and the latter to be very small; the sixth also from some directions appears to be obtusely produced inwards; the tenth on some appears to have a small subbasal inner spine, but this is simply due to pubescence. The dentition of the front *tibiæ* is feeble, and from most directions invisible, although fairly distinct from others.

In this, as in many other species of the genus, the seventh, eighth and ninth joints appear of different shapes according to the point they are viewed from. The sixth and tenth, and even the eleventh, are also occasionally subject to such variation.

## RYBAXIS QUADRITUBERCULATA, n.sp.

♂. Colour and clothing much as in the preceding species.

Head with rather wider impressions than in the preceding species. Length  $1\frac{1}{2}$ -2 mm.

Hab.—Tasmania: Huon River, in tussocks; Hobart, Burnie, Marrawah, Waratah (A. M. Lea).

The colour is much as in the preceding species, except that the darker parts are rather less dark, and that the elytral suture is scarcely deepened in colour. The tenth joint of antennæ also although always decidedly darker than the eleventh, is occasionally no darker than the preceding ones. The antennæ at first appear to be alike in structure, but the fifth joint, although longer than the sixth, is scarcely perceptibly longer than the fourth, the sixth and seventh appear to be produced for a short distance inwards for their entire length (instead of subtriangularly, although from some directions the seventh appears subtriangularly produced), the eighth is much as in that species, whilst the tenth is rather smaller. The prothorax, elytra and abdomen are the same, but the metasternum has two small tubercles (each much smaller than the single one of the preceding species) behind each of the hind coxæ; the front trochanters are finely but acutely dentate, and the front tibiæ are rather strongly dentate at about one-third from the apex, with the space between the tooth and the apex itself emarginate; in the former species the tooth, which is very feeble, is distinctly nearer the base than the apex, and, except at the tooth itself, the curvature of the tibiæ is not interfered with. The females of the two species are practically indistinguishable.

In many respects close to *E. quadriceps*, but smaller, and fifth to eight joints not quite the same; the emargination of the front tibiæ is also distinctly nearer the apex. The two small tubercles on each side of the metasternum distinguish it from *E. adumbrata*. In some respects close to the description of *E. grandis* (♀ only known to Raffray) but smaller, and head not darker than prothorax, &c.

## RYDAXIS CRASSIPES, n.sp.

♂. Of a rather bright reddish-castaneous, elytra and legs somewhat paler, tenth joint of antennæ somewhat infuscated and conspicuously darker than eleventh. With short, pale pubescence.

*Head* with two round, closed, interocular foveæ of moderate size; with a rather large interantennal impression. Antennæ with first joint fairly stout and widest near apex, fifth distinctly longer than fourth or sixth; sixth, seventh and eighth produced on one side, ninth and tenth trapeziform, tenth distinctly larger than ninth, eleventh truncate-ovate, very little longer than tenth. *Prothorax* about as long as wide, sides strongly rounded and widest at about one-third from apex; each side near base with a large fovea, the two connected by a deep impression across middle. *Elytra* comparatively narrow at base; each somewhat membranous and obtusely produced at middle of apex; dorsal striæ deep at base and distinct to near apex, with small but numerous punctures; epipleural furrow deep, almost straight and extending to one-fifth from base and apex. Upper surface of *abdomen* with a transverse medio-basal node, and without striæ or carinæ at sides of same; lower surface flattened in middle. *Metasternum* with a small tubercle close behind each of the hind coxæ. Middle *trochanters* strongly but obtusely dentate, front still more obtusely dentate; four front femora very stout; front tibiæ rather strongly curved, very feebly dentate at about basal third; middle tibiæ rather stout and obtusely produced at apex. Length  $2\frac{1}{4}$  mm.

*Hab.*—Tasmania: Zeehan (K. Findlay).

The four front femora are unusually stout, and in many respects it agrees with Raffray's description of *E. flavipes* (from New South Wales), but ninth joint of antennæ not three times as long as eighth, the apical joint pale, and abdomen without carinæ. In Raffray's description he says: "Carinulis abdominalibus brevibus, divergentibus, et parum distantibus," but Schaufuss says: "Abdominis . . . primo prope suturam oblique bistriolato."

From some directions the sixth, seventh and eighth joints appear to be produced on one side, and the produced points then



directed forwards, the three appearing identical in this respect; but from other directions each joint appears of different shape, with the sixth decidedly larger than the eighth, and not at all pointed. From some directions the tip of the eleventh is seen to be slightly bent inwards. The subbasal prethoracic impression is produced backwards at its middle, so that the base itself appears to be in two lobes.

RYBAXIS ALEATORIA, n. sp.

♂. Bright castaneous, tarsi paler; club infuscated except apical joint, which is palest of all. With very short pale pubescence.

*Head* rather longer than usual; with a deep, round, closed fovea, of moderate size, close to each eye; and a smaller one straight in front, and just behind insertion of antennæ. Antennæ with first joint fairly stout, second subglobular, fifth about twice the length of fourth, and more than twice the length of sixth, seventh slightly produced on one side, eighth smaller and more strongly produced, ninth somewhat irregular on one side, tenth considerably larger and trapeziform, eleventh almost as long as ninth and tenth combined. *Prothorax* about as long as wide, sides strongly rounded and widest at about two-fifths from apex; with a fairly large, round fovea, on each side near base, and a much smaller one in middle, the three without connecting impressions. *Elytra* almost as long as wide; dorsal striae distinct to near apex; punctures indistinct, with a narrow marginal stria, but epipleural furrow absent. Upper surface of *abdomen* with a small medio-basal node; lower surface with a transverse depression at apex of second segment. *Metasternum* gently concave in middle. *Legs* longer than usual; front and middle trochanters obtusely dentate; front tibiae rather suddenly curved at apex. Length 2 mm.

*Hab.*—New South Wales: Sydney (A. M. Lea).

The unique male was seen by M. Raffray some years ago, but returned without comment. The tenth joint is slightly paler than the three preceding ones, but is conspicuously darker than the eleventh. From the other species having the eleventh joint

paler than the preceding ones it is readily distinguished by the sculpture of head, and under surface of abdomen, and by the absence of an impression connecting the prothoracic foveæ.

The foveæ on the head are placed exactly as on the four of a die; the interocular ones are smaller than in the three preceding species. There is an obtuse tubercle on each side of the metasternum, but the tubercles, instead of being erect, are pressed flat down, so that they overhang the hind coxæ; in consequence they are not readily seen, and at first they appear to be really attached to the coxæ.

*RYBAXIS ACUTIDENS*, n.sp.

♂. Of a bright pale castaneous, legs and palpi still paler, apical two-thirds of antennæ infuscated. Abdomen finely pubescent, elsewhere almost or quite glabrous.

*Head* rather large, with a fovea of moderate size close to each eye, and with a rather vague interantennal impression. Antennæ with first joint subcylindrical, second subglobular, fifth slightly longer than fourth, but scarcely, if at all, longer than sixth, eighth very small, ninth larger and produced on one side, tenth large, eleventh slightly narrower than tenth, but slightly longer than ninth and tenth combined. *Prothorax* distinctly transverse, sides strongly rounded and widest at about two-fifths from apex; each side near base with a large fovea, the two connected by a strongly impressed curved line, that is scarcely dilated at its middle. *Elytra* rather wide; dorsal striæ distinct almost to apex, with small but fairly numerous and distinct punctures; epipleural furrow deep, lightly curved and extending to about one-fifth from base and apex, marginal stria rather deeper than usual. Upper surface of *abdomen* with a very short oblique stria on each side of the medio-basal node; lower surface slightly flattened in middle. *Metasternum* concave along middle. *Front trochanters* each with a long thin tooth; front tibiae moderately curved, the four hind ones longer and more noticeably curved, the hind pair spinose at apex. Length  $1\frac{1}{2}$ - $1\frac{3}{4}$  mm.

*Hab.*—W. Australia: Bunbury, Vasse River (A. M. Lea).

The dark club, which is rather larger than usual, with the acute armature of the front trochanters, render this species very distinct.

The eleventh joint is slightly paler than the tenth, but not distinctly so, and is considerably darker than the basal joints. From some directions the tenth joint appears feebly bidentate on one side, but this appearance (although alike on two specimens) may be due to the clothing. One specimen was seen by M. Raffray some years ago, but returned without comment.

RYBAXIS ATRICLAVA, n.sp.

♂. Dark reddish-castaneous, head and abdomen black; appendages, club excepted, almost flavous. Upper surface with short pale pubescence, more noticeable on abdomen than elsewhere.

*Head* with a round closed fovea of moderate size close to each eye, and with a fairly deep interantennal impression. *Antennæ* comparatively thin, first joint cylindrical, fifth slightly longer than fourth or sixth, sixth than seventh, and seventh than eighth, ninth larger, tenth still larger, eleventh rather briefly subovate, about as long as ninth and tenth combined. *Prothorax* not much wider than long, widest and strongly rounded at about one-third from apex; latero-basal foveæ and connecting impression as in the preceding species. *Elytra* moderately long, each slightly produced in middle of apex; dorsal striæ deep at base, and distinct almost to apex; with fairly distinct but irregularly distributed punctures; epipleural furrow fairly deep, lightly curved and rather nearer marginal stria than usual. Upper surface of *abdomen* with two small medio-basal nodes. *Metasternum* on each side, exactly half-way between the middle and hind coxæ, raised into a very obtuse tubercle, the apical inner portion feebly striated. *Front tibiæ* very feebly dentate at the middle; hind pair spinose at apex. Length  $1\frac{3}{4}$  mm.

♀. Differs in being thinner, antennæ shorter, abdomen convex along middle of undersurface, metasternum unarmed and not striated, and legs unarmed.

*Hab.*—Victoria: Mallee (National Museum).

The entirely dark club, curious metasternum and front tibiae, render this species very distinct. The undersurface of the abdomen of the type-male appears to be concave along the middle and obtusely tuberculate in places, but is so gummy that I may be mistaken as to the tubercles; and, as it is rather damaged, it was not subjected to treatment to remove the gum.

The elytra, except at base and suture, are slightly paler than the prothorax. The three apical joints of the antennae are almost black; and from no direction do any appear produced on one side. The front tibiae from the base to the middle very feebly increase in width, and then rather suddenly decrease and become very feebly curved to the apex; from the middle, a seta projects. I have regarded them as dentate, but that is perhaps hardly correct.

*RYNAXIS VARIABILIS*, n.sp.

♂. Of a rather bright reddish-castaneous, appendages slightly paler, abdomen slightly darker, head still darker, sometimes almost black. With fairly uniform, pale, and rather short pubescence.

*Head* with a fairly large round closed fovea close to each eye; and with a large, shallow, interantennal depression. *Antennae* rather long, first joint rather stout and subcylindrical, fifth slightly longer than fourth and just perceptibly longer than sixth, seventh and eighth decreasing in length, ninth slightly longer and wider than eighth, tenth decidedly larger and trapeziform, eleventh slightly longer than ninth and tenth combined. *Prothorax* almost as long as greatest width, sides widest and strongly rounded at about one-third from apex; each side near base with a large fovea, the two connected by a strong curved impression, which is slightly drawn backwards at middle; with a narrow impression almost at extreme base. *Elytra* dilated posteriorly; dorsal stria deep at base and very distinct to near apex; with rather distinct but irregularly distributed punctures; epipleural furrow deep, straight, and short. Upper surface of *abdomen* with a transversely oblong medio-basal node; lower surface gently flattened in middle, the penultimate segment feebly concave in

middle. *Metasternum* gently depressed along middle. Four front *trochanters* each with a small but acute tooth; *tibiæ* rather long. Length 2-2½ mm.

♀. Differs in having shorter antennæ with smaller club, epipleural furrow shallower, abdomen rather strongly convex on under surface, *metasternum* gently convex and *trochanters* unarmed.

*Hab.*—Tasmania (National Museum), Mount Wellington, Hobart, two specimens from fungi, and others from moss (A. M. Lea).

A moderately elongate species, much the shape of *E. adumbrata*, but tenth joint not darker than eleventh, and *tibiæ* unarmed. In some respects close to description of *E. ovensensis*, but head dark and with different sculpture, and hind *tibiæ* not strongly curved at apex.

The head is sometimes but little or no darker than the prothorax, but is usually conspicuously darker; the abdomen is usually just perceptibly darker than the elytra. One specimen has the elytra (except the extreme outer and apical edges) and abdomen (except the tips of the segments) deep black. Another has the elytra and abdomen entirely black. Another has the abdomen black (except the tips of the segments) and the elytra (the discs slightly diluted) and prothorax much darker than usual. Another has the whole body of a uniform shade of reddish-castaneous, with the appendages slightly paler. In all, however, the antennæ are uniform, the tenth and eleventh joints not being at all contrasted in colour. From some directions the interocular foveæ appear to be shallowly open in front, but I think they should be regarded as closed. The epipleural furrow commences at the basal fourth, and terminates just beyond the middle, so that it is shorter than usual.

#### RYBAXIS HIRSUTA, n.sp.

♂. Of a rather bright reddish-castaneous, elytra (suture and base excepted) and appendages somewhat paler, With short and

rather sparse pale pubescence; in addition, with some longer hairs scattered about.

*Head* with a deep, round, closed fovea, of moderate size, close to each eye; and with a distinct interantennal depression. *Antennæ* with second joint subglobular, fifth slightly longer than fourth or sixth, ninth slightly longer and wider than eighth, tenth larger and trapeziform, eleventh rather briefly truncate-ovate, about as long as ninth and tenth combined. *Prothorax* distinctly transverse, widest and strongly rounded close to apex; with a large fovea on each side near base, and a somewhat smaller one in middle, the three connected by distinct curved lines; extreme base with a row of rather coarse but partially concealed punctures. *Elytra* rather wide, dilated to beyond the middle; with eight small basal foveæ; dorsal striæ deep at base, but less distinct elsewhere than usual; punctures sparse and indistinct; marginal stria deeper than usual but epipleural furrow absent. Upper surface of *abdomen* with a transversely elongate medio-basal node, from each side of which proceeds a distinct oblique stria; lower surface with a feeble depression in middle of second segment. *Metasternum* widely and rather strongly concave. Middle *trochanters* acutely dentate; four front tibiae moderately stout, the hind pair decidedly thinner and spinose at apex. Length  $1\frac{1}{2}$ - $1\frac{2}{3}$  mm.

♀. Differs in having shorter antennæ, with the club somewhat smaller, under surface of abdomen moderately convex, metasternum depressed along middle only, and legs unarmed.

*Hab.*—Tasmania: Huon River, Mount Wellington, Stonor (A. M. Lea).

In appearance somewhat like large specimens of *R. 5-foveata* and *R. electrica*, but the three subbasal foveæ of prothorax conspicuously joined together, although the connecting lines are rather less deeply impressed than usual.

The longer hairs appear to be absent from some of the specimens before me, but are really present, being pressed down amongst the pubescence, this being due to the treatment received. One specimen is entirely pale castaneous, probably from imma-

turity. The first joint of the antennæ is really distinctly longer than the second, but as its base is more or less concealed from certain directions, it appears to be even shorter than the second, or at least no longer. Between the antennæ, from some directions, there may be seen three impressions, the ordinary one but of rather smaller size than usual, and a smaller foveate one quite close to the base of each antenna, the three being obscurely connected together.

A male from Mount Wellington differs from the typical form in having the interocular foveæ open in front (from some directions, however, they appear closed), the elytra with more distinct punctures (especially near suture), and the dorsal striæ more distinct and longer. As in all other respects, however, even as to the longer hairs scattered about (an unusual feature in the genus), it agrees with the typical form, it is not considered advisable to regard it as more than a variety.

*RYBAXIS ACANTHOSTERNA*, n.sp. (Plate xxi., fig.3).

♂. Of a rather dark reddish-castaneous, elytra and appendages paler. Moderately clothed with short, pale pubescence.

*Head* with a fairly large, round, deep fovea, close to each eye, and a moderately deep depression between antennæ. Antennæ rather long, first joint stout, second shorter than third and scarcely, if at all, wider, fifth slightly longer than fourth and sixth, seventh and eighth shorter, ninth longer and wider, tenth distinctly longer than wide, eleventh very decidedly curved, its inner base concave. *Prothorax* moderately transverse, sides widest and strongly rounded at about apical third; each side near base with a large fovea, the two connected by a strong curved impression, which is drawn backwards, but scarcely foveate, at its middle. *Elytra* about as long as wide; dorsal striæ deep at base and distinct to beyond the middle; punctures rather indistinct; epipleural furrow deep, lightly curved, and extending to about one-fifth from base, and one-fourth from apex. Undersurface of *abdomen* concave in middle, a distinct tubercle projecting backwards from each side of the depression on third segment. *Metasternum* gently and

widely concave, but just behind intercoxal process of mesosternum with a strong, acutely conical tubercle or spine. *Legs* rather long; front trochanters obtusely dentate; front tibiae thin, with a distinct median tooth. Length  $2\frac{1}{2}$  mm.

*Hab.*—Queensland (Taylor Bros.), Coen (H. Hacker).

The antennae approach those of *R. hyalina*, but the eleventh joint is distinctly longer and thinner, and slightly concave on one side of base, the ninth and tenth are also longer. But the whole insect is larger, the legs are longer, and the metasternum and abdomen are very different. The species is perhaps the most distinct one of its genus.

Of the two specimens before me, one has the head conspicuously darker than elsewhere; the other is distinctly paler, with the head but little darker than the prothorax. From some directions the tenth joint appears to be but little longer than wide, but from others it appears almost twice as long as wide; the ninth is also of somewhat irregular shape. From some directions the dorsal striae appear geminate towards the base.

RYBAXIS BRYOPHILA, n.sp.

♂. Bright reddish-castaneous, elytra and appendages slightly paler. With short, depressed, pale pubescence.

*Head* with a large round fovea close to each eye, and one of larger size in the middle in front, but slightly behind antennae. *Antennae* comparatively stout, second and fifth joints almost as long as wide, third and fourth feebly transverse, sixth moderately, seventh, eighth and ninth strongly transverse, tenth large, its inner apex acutely produced, eleventh briefly ovate, very little longer than tenth. *Prothorax* distinctly transverse, sides widest and strongly rounded at about one-third from apex; each side near base with a large fovea, middle with a somewhat smaller one, the three connected by distinct but narrow lines. *Elytra* dilated posteriorly, but not to apex; with six small basal foveae; dorsal striae sharply defined on basal three-fifths, but then vanishing; with numerous fairly distinct punctures; epipleural furrow short. Lower surface of abdomen gently flattened in



middle. *Metasternum* widely and shallowly concave. Front *trochanters* rather acutely dentate; front tibiae regularly increasing in width, but near apex suddenly and strongly emarginate to apex itself, the emarginations rather densely clothed, middle tibiae rather acutely mucronate at apex, the hind pair less noticeably so. Length  $1\frac{1}{2}$ - $1\frac{3}{4}$  mm.

♀. Differs in having somewhat shorter antennæ, with none of the joints produced inwards, the tenth much smaller, the eleventh simple at its inner base and fully twice the length of the tenth, the undersurface of abdomen convex, *metasternum* less widely and more shallowly concave, and legs unarmed.

*Hab.*—Tasmania: Hobart, Mount Wellington, New Norfolk.

The body is somewhat as in *R. 5-fossata*, but the antennæ are stouter and shorter, tenth joint different, abdomen non-carinate, etc. On some specimens the elytra are of a uniform shade of colour, but on others the suture, sides and apex are slightly darker than elsewhere. The medio-frontal cephalic fovea is larger than the interocular ones (with which, from some directions, it appears to be vaguely connected), closed in front and not circular. The eleventh joint of the male on the undersurface has a slight depression in which the produced inner apex of the tenth can be fitted. From some directions the eighth and ninth are seen to be produced inwards. The epipleural furrow is short; it commences and is fairly deep at about the basal fifth, but rapidly shallows and terminates about the middle; in the female it is less distinct than in the male.

Abundant in moss, and a few specimens taken from tussocks, and rotting leaves.

*RYBAXIS PALLIDA*, n.sp.

♂. Of a rather pale castaneous, appendages still paler. With short, pale, and, for the genus, fairly dense pubescence.

*Head* comparatively wide, with (for the genus) a rather small fovea close to each eye, and with a rather shallow subfrontal impression. Antennæ comparatively thin, second joint fairly large, third to sixth of about even size, seventh and eighth somewhat smaller, ninth slightly larger, and tenth slightly larger still,

eleventh ovate, slightly longer than the three preceding joints combined. *Prothorax* strongly transverse, sides strongly rounded, widest close to apex; with a rather large, and somewhat transverse fovea, on each side near base, and with a small round median one; with numerous small punctures. *Elytra* moderately transverse; dorsal striae distinct, more noticeably curved than usual, and terminating at apex itself close to the suture; with numerous small punctures; marginal stria distinct but epipleural furrow absent. *Abdomen* somewhat flattened along middle of under surface, the apical segment with a rather shallow longitudinal impression. *Metasternum* rather widely concave in middle; but the depression closed posteriorly. Four front *trochanters* obtusely dentate; tibiae rather long. Length  $1-1\frac{1}{2}$  mm.

*Hab.*—Queensland: Cairns (H. Hacker's No. 204).

In general appearance fairly close to *R. electrica*, but the middle trochanters distinctly dentate, and tenth joint of antennae much smaller, so that the eleventh appears to be conspicuously larger, although it is about the same size in both species; and, in fact, the club appears to be one-jointed only.

The cephalic foveae are placed as in the preceding species, but the two have little else in common. The three prothoracic foveae are disconnected, but from some directions a faint impression can be seen proceeding inwards from each of the lateral foveae, but not quite touching the median one.

*RYBAXIS MACROCEPHALA*, n.sp. (Plate xxi., fig. 4).

♂. Bright reddish-castaneous; elytra and appendages slightly paler. With short, pale pubescence.

*Head* much larger, wider, and more convex than usual; with a small fovea fairly close to each eye, but not depressed between antennae; with rather dense distinct punctures. Antennae with third and fourth joints slightly shorter than second and fifth, sixth to ninth still shorter, tenth larger and somewhat transverse, eleventh large, ovate, about as long as the four preceding joints combined. *Prothorax* distinctly transverse, sides widest and strongly rounded towards apex; with dense clearly defined punctures; with a fairly

large fovea on each side near base, and a small one in middle. *Elytra* not much wider than long, dorsal striae finely impressed to just beyond the middle, and then vanishing; marginal striae deep, but epipleural furrow absent. Undersurface of *abdomen* with two conspicuous parallel ridges extending to apex of second segment, third and fourth not traceable across middle. *Metasternum* strongly concave in middle, the concavity bounded behind by a thin intercoxal lamina; with a small fovea close to each of the middle coxæ. *Tibiæ* rather long, especially the hind pair, which are also rather strongly curved at apex. Length  $1\frac{1}{2}$  mm.

*Hab.*—N. S. Wales: Illawarra, Grose Valley, Blue Mountains; a single male from each locality (H. J. Carter).

The enormous head (in the female it is probably smaller) readily distinguishes it from all other species of the genus (or indeed of the family) known to me. The medio-basal fovea of the prothorax is not connected with the sides, although there is an impression on each side which almost touches it and the lateral ones; the species therefore belongs to M. Raffray's second group of the genus, although he would possibly regard it as representing a new genus.

The interocular foveæ are smaller and more distant from the eyes than usual; from some directions they appear to be closed, but from others a vague depression can be seen opening out in front from each of them. The antennæ appear to have the club one-jointed, as the tenth joint, although decidedly longer and wider than the ninth, is very much smaller than the eleventh. There are fairly numerous punctures on the elytra, but they are much less distinct than those on the prothorax.

The males of the species here described may be tabulated as follows:—

A. Foveæ of prothorax disconnected.

- |  |                      |
|--|----------------------|
| a. Abdomen with two conspicuous parallel ridges on under surface ..... | <i>macrocephala.</i> |
| aa. Abdomen without such ridges.                                       |                      |
| b. Metasternum with two depressed tubercles overhanging coxæ .....     | <i>alsatoria.</i>    |
| bb. Metasternum without tubercles.....                                 | <i>pallida.</i>      |

## AA. Fovæ of prothorax connected.

## B. Front tibiæ edentate.

c. Antennæ of uniform colour..... *variabilis*.cc. Antennæ with club dark ..... *acutidens*.

## BB. Front tibiæ dentate or emarginate.

C. Epipleural furrow absent ..... *hirsuta*.

## CC. Epipleural furrow present.

D. Metasternum without tubercles..... *bryophila*.DD. Metasternum with one conspicuous tubercle *acanthosterna*.DDD. Metasternum with four small tubercles. *quadrilobulata*.

DDDD. Metasternum with two tubercles.

E. Four front femora very stout..... *crassipes*.

EE. Femora not conspicuously stout.

F. Tubercles much nearer hind than  
middle coxæ..... *purvidens*.FF. Tubercles equidistant from mid-  
dle and hind coxæ..... *atriclava*.

## RYBAXIS HARTI Blackb.

In these Proceedings for 1900 (p.151), M. Raffray stated that this name was a synonym of *R. Isidoræ*, basing this statement on the description of the intermediate tibiæ. There are before me, however, two species which have the four front tibiæ peculiar, and these I believe to be *R. Harti* and *R. Isidoræ*.

The legs and antennæ of *R. Isidoræ* (the male which I refer to *R. Isidoræ* agrees with the description of *R. antilope*; it is rather larger than the female) are stouter than in *R. Harti*, the front tibiæ are more noticeably armed, and the median pair with the armature of the strongly emarginated portion rather less conspicuous; the second joint of antennæ is also considerably larger. The elytral striation is more pronounced, and the upper surface of the abdomen has the oblique impressions still shorter. But the two are readily distinguished by the terminal joint of the antennæ. In *R. Harti* the apical joints are infuscate (Blackburn says "apicem versus infuscatis"). In *R. Isidoræ* the eleventh joint is conspicuously paler than the tenth (Schaufuss says "articulo ultimo . . . pallidis").

The type of *R. Isidora* was from King George's Sound; my specimens (sexes) are from Vasse (not far from the Sound) and Swan River.

*RYBAXIS ISIDORE* Schauf. (*R. antilope* Raffr. (?)).

*R. Harti* is not a synonym of this species (see above note). But I think the male has been described by M. Raffray under the name of *R. antilope*.

*RYBAXIS ELECTRICA* King.

This is probably the commonest species of *Pselaphidæ* in Tasmania. It may be taken abundantly in moss and fallen leaves, and on fence-tops, etc., at dusk.

Var. A.—Numerous Tasmanian specimens before me appear to represent a variety. They differ from the typical form in being slightly larger, slightly more depressed, and with the small basal foveæ of elytra rather more pronounced. The colour also is rather brighter. Some of the larger of these specimens closely resemble *R. 5-foveata*, but have the eleventh joint of antennæ distinctly smaller.

*PSELAPHUS FOVEIVENTRIS*, n.sp.

♂. Bright reddish-castaneous, palpi and tarsi paler. Very sparsely clothed with pale depressed pubescence; elytra not fringed at apex, but with the pubescence forming three feeble lines on each. Undersurface with dense white pubescence on base of abdomen, on mesosternum and at apex of prosternum.

*Head* rather narrow, with a continuous median groove but somewhat irregular between eyes, without tubercles between eyes. *Antennæ* long and thin, all the joints distinctly longer than wide, first longer than the three following combined. *Palpi* elongate, club of apical joint elliptic, rather more than one-third the length of peduncle, which is moderately curved. *Prothorax* much longer than wide, rather strongly convex; with four subbasal foveæ, all feebly connected together, the outer ones produced slightly backwards. *Elytra* much shorter than abdomen, not

much wider than long; sutural strise distinct, the others feeble. Under surface of *abdomen* with a rather deep, suboval, median fovea. Metasternum with a wide, polished, median excavation, continuous throughout but narrowed to base. Length  $2\frac{1}{4}$ - $2\frac{3}{4}$  mm.

♀. Differs in the metasternum being flattened along middle, and the abdomen without a fovea.

*Hab.*—Tasmania : Mount Wellington, Hobart, Waratah (A. M. Lea).

From some directions each side of base of prothorax appears to be supplied with two deep grooves, with a narrow carina between them. The species is longer and narrower, with the basal joint of antennæ longer than usual, and the sexual characters very pronounced. Of the twelve specimens before me, six were taken from moss, and six from fallen leaves.

*PSELAPHUS TUBERCULIVENTRIS*, n sp.

♂. Bright reddish-castaneous, palpi and tarsi somewhat paler. Sparsely clothed with pale, subdepressed pubescence; elytra fringed at apex, and with feeble lines of pubescence on disc. Under surface with dense white pubescence at base of abdomen, on mesosternum, apex of prosternum and middle of neck.

*Head* moderately long, with a distinct median channel from base to apex, but irregular between eyes. Antennæ moderately long, first joint as long as the three following combined, second to eighth but little, or not at all, longer than wide, ninth and tenth longer than wide, and combined about equal to eleventh. Palpi elongate, club of apical joint about half the length of peduncle, this distinctly curved. *Prothorax* very distinctly longer than wide, with five subbasal impressions. *Elytra* much shorter than abdomen, about as long as wide; sutural stria distinct, discal fairly distinct. Undersurface of *abdomen* strongly convex in middle, and at its highest part with a strongly raised truncated tubercle. Length  $2\frac{1}{2}$  mm.

♀. Differs in having shorter antennæ and abdomen non-tuberculate.

*Hab.*—Tasmania: Mount Wellington, Hobart; four specimens, from moss (A. M. Lea).

In general appearance close to the preceding species, but the antennæ shorter, elytra fringed at apex, and the male characters very different.

The head appears to have, from some directions, two conspicuous interocular tubercles, but these are due principally to the median groove, although partly also to their own elevation. The medio-basal impression on the prothorax is separated from the others by a feeble carina on each side; the lateral ones are longitudinal, the intermediate ones transverse. From some directions there appears to be a strong transverse subbasal groove slightly interrupted on each side of middle.

*PSELAPHUS VILLOSUM*, n.sp.

♂. Bright reddish-castaneous, legs and antennæ paler, tarsi and palpi somewhat flavous. Clothed with long straggling dark setæ, on the elytra (which are not fringed at apex) rather sparser on disc than elsewhere. Under surface with dense pale pubescence at base of abdomen, on each side of mesosternum and on apex of prosternum.

*Head* moderately long, with a wide but feeble median channel. Antennæ moderately long, first joint as long as second and third combined, second stouter and slightly longer than third, third to eighth about as long as wide, ninth and tenth subglobular, not longer than wide, their combined length about equal to eleventh. Palpi elongate, club of apical joint more than half the length of peduncle. *Prothorax* much longer than wide, with a moderate and somewhat curved subbasal impression, dilated in places by five feeble foveæ, of which the lateral ones are oblique and almost isolated. *Elytra* much shorter than abdomen, much wider than long; sutural and discal striæ distinct, the latter strongly curved and continuous. Basal segment of *abdomen*, on undersurface of first segment, with a wide, shallow, median, longitudinal impression. Length  $1\frac{1}{2}$ – $1\frac{3}{4}$  mm.

♀. Differs in having somewhat shorter antennæ, and legs and abdomen without a longitudinal impression.

*Hab.*—Tasmania : Launceston (A. M. Lea).

In Raffray's Table would be associated with *P. pilosus* and *P. longepilosus*; from the former distinguished by the non-tuberculated head, and from the latter by the cephalic groove being feeble posteriorly and sides of prothorax non-carinate.

The cephalic groove from some directions appears to be terminated between the eyes, but from others is seen to be feebly continued to the neck. From some directions there appear to be two feeble interocular tubercles, but this appearance is due entirely to the groove.

*PSSELAPHUS BRYOPHILUS*, n.sp.

♀. Bright reddish-castaneous, appendages paler. Clothed with very sparse, long, straggling, dark setæ. Undersurface with dense white pubescence at base of abdomen, on mesosternum, apex of prosternum and head.

*Head* rather long, channel wide and shallow in front, deeper and narrower behind, but interrupted between eyes. Antennæ long and thin, all the joints distinctly longer than wide, first slightly longer than second and third combined. Palpi long and thin, club of apical joint less than half the length of peduncle. *Prothorax* much longer than wide, sides evenly rounded; with a strong and somewhat curved subbasal impression, connecting five small foveæ, of which the lateral ones are longitudinal and almost disconnected. *Elytra* much shorter than abdomen, distinctly wider than long, base narrower than usual; subsutural and discal striæ distinct, the latter narrowly impressed and terminated before apex. *Legs* rather thinner than usual. Length  $1\frac{1}{2}$  mm.

*Hab.*—Tasmania : Frankford, in moss (A. M. Lea).

Thinner than the preceding species, antennæ considerably longer, long hairs longer and sparser (on the elytra there are only seven of them on the type), and head distinctly grooved to neck. It has much the size and appearance of *P. elongatus*,



but antennæ longer and body with long clothing. The head from some directions appears to be feebly lobed, but there are no distinct interocular tubercles.

*PSELAPHUS PULCHELLUS*, n.sp.

♀. Bright reddish-castaneous, some parts darker. Clothed with long, straggling, dark setæ, on the elytra (which are feebly fringed at apex) confined to sides, and rather denser on apical half of abdomen (where there are a few pale, short setæ interspersed) than elsewhere. Undersurface with dense white pubescence at base of abdomen, on mesosternum and head.

*Head* elongate, with a continuous median channel, interrupted in middle by a small granule; with two tubercles between eyes. Antennæ rather long, first joint as long as second and third combined, ninth and tenth rather long, their combined length distinctly more than that of eleventh. Palpi elongate, club of apical joint one-third the length of peduncle. *Prothorax* distinctly longer than wide, base much wider than apex; with a rather strong, subbasal impression, connecting five shallow foveæ, of which the lateral ones are deeper, longitudinal and almost isolated. *Elytra* no shorter than abdomen, about as long as wide, apex not twice the width of base; sutural and discal striæ distinct, the latter narrow, rather strongly curved and continuous throughout. Length  $2\frac{1}{2}$  mm

*Hab.*—Tasmania: Frankford (A. M. Lea)—New South Wales: Illawarra (H. J. Carter).

A beautiful species, with long hair somewhat as in *P. pilosus* and the two preceding species, but otherwise very different. In some respects close to *P. longepilosus*, but head conspicuously bituberculate and sides of prothorax not carinate. The elytra are also without long hairs except at the sides.

The elytra are brightly castaneous, but somewhat darker along suture and apex, where the colour is much the same as that of head and upper surface of abdomen; the prothorax is of a chocolate-brown. The antennæ are slightly paler than the head, but darker than the legs, except that the knees are infuscated.

The palpi are almost flavous, but with the upper surface of the club as dark as the rest of the head. From some directions the tubercles between the eyes are very conspicuous, and from others there appear to be two conspicuous tubercles between the bases of the antennæ.

*PSELAPHOPHUS BINODOSUS*, n.sp.

♂. Reddish-castaneous; upper surface, except elytra, darker; palpi flavous. Clothed with fine, recurved, dusky pubescence.

*Head* with a fairly deep but rather small fovea close to each eye; antennary ridges separated by a shallow depression. Antennæ rather thin, passing middle coxæ, first joint fairly stout, as long (when seen from below) as the two following joints combined, second slightly longer than third, third to eighth small and subequal, ninth larger and subglobular, tenth larger again, eleventh somewhat irregularly ovate. *Prothorax* about as long as wide, gently increasing in width to near apex, near base with a strong and slightly curved impression; marked with a few indistinct punctures in middle, and terminated on each side by a short, deep, longitudinal impression. *Elytra* wider than long, each with a strong sutural, and a strong curved discal stria, becoming subfoveate at base. *Abdomen* with second segment large, and on undersurface with a shallow median impression (scarcely a fovea). *Metasternum* with a large, but rather shallow apical impression. Undersurface of head with two very distinct, round, flattened tubercles. *Femora* stout, *tibiæ* lightly curved. Length 1½-2 mm.

♀. Differs in having undersurface of abdomen convex, metasternum narrowly impressed in middle of apex, femora thinner, and *tibiæ* straighter.

*Hab.*—Tasmania: Burnie, Frankford (A. M. Lea).

Larger and wider than *P. clavatus*, *P. unicolor*, or *P. bicolor* and sculpture of head somewhat different. From the description and figure of *P. atriventris*, the absence of a single large interocular fovea at once distinguishes it. On one specimen the upper surface of abdomen (except the margins) is blackish-brown.

## TYRAPHUS MAJOR Sharp.

There are before me three of each sex of a species that agrees well with the description of this species. But one specimen was before Sharp, and he considered it a male, although stating that the "metasternum and hind body are not impressed." The type, however, was a female. The male differs in having a distinct tubercle on the middle of the undersurface of the large abdominal segment; seen directly from above, this tubercle appears as a short carina, but from the sides it appears subtriangular.

*Hab.*—W. Australia : Vasse (in flood-débris).

## CTENISOPHUS NOCTIVAGUS, n.sp.

♂. Pale reddish-castaneous, appendages somewhat paler. Moderately clothed with pale, scale-like setæ, denser at apex of elytra and on the basal segments of abdomen than elsewhere.

*Head* with two very shallow foveæ between eyes. *Antennæ* rather long, first joint as long as second, but from some directions apparently shorter, second stouter and slightly longer than third, third to seventh small and subequal, eighth to eleventh about three-fifths the total length of antennæ, eighth cylindrical, distinctly longer than ninth or tenth, these subequal *inter se*, eleventh elongate-elliptic, slightly longer than ninth and tenth combined. Three apical joints of palpi each with a long, thin, appendage. *Prothorax* lightly transverse, widest near apex, thence very feebly decreasing in width to base; with a large but rather shallow sub-basal fovea. *Elytra* each with a distinct sutural stria, and a rather less distinct, and somewhat curved, discal one. *Metasternum* deeply sulcate. *Abdomen* with third segment large; its undersurface somewhat flattened (scarcely impressed) in middle. *Legs* long and thin. Length 1 mm.

♀. Differs in having shorter antennæ, of which the ninth joint is no longer than the eighth, the tenth distinctly longer and stouter than the ninth (but shorter than in the male), and the eleventh joint shorter and stouter than in the male and almost as long as the four preceding joints combined. The third ventral segment is also regularly convex.

*Hab.*—Queensland: Cunnamulla, attracted to lights(H. Hardcastle)—New South Wales: Tamworth(A. M. Lea).

Close to the description of *C. parvus*, but base of prothorax decidedly narrower than near apex. Very close to *C. vernalis*, but smaller, eighth joint slightly longer and thinner, and spines on undersurface of head much less distinct. The absence of an abdominal fovea in the male distinguishes it from *C. rivularis*.

*OTENISOPHUS LONGICORNIS*, n.sp. (Plate xxi., fig.5).

♂. Of a rather dark reddish-castaneous, appendages somewhat paler, abdomen darker, except at tip. Clothing much as in the preceding species.

*Head* with two round and rather shallow foveæ between eyes. Antennæ decidedly longer than usual; first joint stouter than second and slightly longer(but from some directions apparently shorter), second stouter and slightly longer than third, third to seventh small and subequal; eighth to eleventh about two-thirds the total length of antennæ; eighth cylindrical, almost the length of ninth and tenth combined, ninth and tenth subequal, eleventh elongate-subelliptic, distinctly longer than ninth and tenth combined. Three apical joints of palpi each with a long thin appendage. *Prothorax* moderately transverse, sides widest at apical third, thence distinctly decreasing in width to base, which is not much wider than apex; with a fairly large but rather shallow sub-basal fovea. *Elytra* each with a strong sutural stria, and a lightly curved discal one not quite so strongly impressed; with numerous distinct punctures. *Metasternum* deeply sulcate. *Abdomen* with third segment large, its under surface feebly flattened(not at all impressed) in middle. *Legs* long and thin. Length  $1\frac{1}{4}$  mm.

♀. Differs in having shorter antennæ, with the third to ninth joints short and subequal, the tenth stouter and longer than ninth(but much shorter than in male) and the eleventh shorter and stouter than in the male, and as long as the four preceding combined.

*Hab.*—Tasmania: Jordan River, in flood-débris(A. M. Lea)

The long eighth joint of the antennæ of the male readily distinguishes it from all other species known to me. *C. Andersoni* (certainly described from a male) has the eighth joint of the same length; but the species is described as about twice the length of the present one, and is the largest as yet recorded from Australia.

#### NARCODES VARIA King.

A cotype of this species is before me; its front trochanters are obtusely tuberculated, scarcely armed, and its ventral segments are convex, so it is probably a female. The front angles of its prothorax appear from some directions as small subconical tubercles. King says "*angulis anticis acutis*" and again "the angles in front being acute." In his figure however (Plate v., fig.1) the apices are not shown as acute as in my specimen, and the elytra are figured as considerably longer than they really are\*. King described *N. pulchra* as a different species, but afterwards (p.106) stated it was the male of *N. varia*; he did not; however, describe the abdomen, nor the armature of its legs.

A specimen from Mount Kosciusko agrees fairly well with King's description of *N. pulchra*, and with his figure of the palpi (Plate v., fig.2a), except that the joints are more inflated towards the apex and thinner towards the base. The colour, however, is not as described "*Fumosus, maculis nigris irregularibus*" but is of an almost uniform dingy brown; this, however, may be immaterial. Its front trochanters are large, and each has a strong tooth directed outwards and about the size of that on the femur, which is rather larger than on the cotype of *N. varia*. Its ventral segments are somewhat flattened along middle, and the second is shallowly transversely impressed.

#### NARCODES NIGRIVENTRIS, n.sp. (Plate xxi., fig.6).

♂. Black, head and prothorax dark brown, elytra and legs reddish-castaneous, but club and femora more or less infuscated. Clothed with short and pale, but rather stiff pubescence.

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\*In a later note, however, he states that the figure is unsatisfactory.

*Head* distinctly transverse, very little wider across eyes than at extreme base; with a narrow depression between antennary ridges, and with two small interocular foveæ; coarsely and densely punctate. *Antennæ* passing middle coxæ, first joint subcylindrical, its base partially concealed, second slightly shorter and stouter than third, the others to eighth feebly decreasing in length, ninth about twice as long and twice as wide as eighth, tenth slightly larger than ninth, eleventh subovate, as long as ninth and tenth combined. *Prothorax* transverse, sides very little rounded, base not much narrower than greatest width, which is near apex; with a large, shallow, medio-basal impression, and a feeble subbasal one on each side; punctures as on head. *Elytra* widely transverse, much wider at apex than at base; dorsal striæ traceable almost to apex; with several very feeble depressions; coarsely and densely punctate. *Abdomen* with second and third segments large and dilated posteriorly, fourth parallel-sided, fifth and sixth decreasing in width; lower surface with a large shallow depression. *Metasternum* densely punctate, flat in middle. *Legs* rather long; front trochanters each with two small acute teeth of almost equal size; front femora acutely dentate near base; middle trochanters each moderately acutely dentate; four front tibiæ somewhat curved and obtusely spurred at apex, hind tibiæ longer, less curved, and not spurred. Length  $2\frac{1}{2}$ - $2\frac{1}{2}$  mm.

♀. Differs in having the antennæ shorter, with the club somewhat smaller; prothorax with sides slightly more rounded, and abdomen gently convex on undersurface.

*Hab.*—Tasmania: Evandale Junction, in tussocks (A. M. Lea).

Readily distinguished from *N. varia* by the front angles of the prothorax rounded off in both sexes, and by the bidentate front trochanters also of both sexes. The abdomen and metasternum are also darker than the other parts of the body.

There is no sexual difference in the armature of the front legs. The clothing appears to be slightly maculate, but this is due more to slight inequalities of the surface and its disposition, than to shades of colour. Along the upper surface of the abdomen there appear to be three very vague stripes. The palpi are peculiar;

the second joint is long, with the basal half thin and strongly curved, and the apex inflated, third short and subovate, but produced at apex into a long and thin spur, fourth thin at the base and dilated towards apex. The medio-basal prothoracic impression is not very distinct.

*PALIMBOLUS FRATER*, n.sp.

♂. Reddish-castaneous, appendages paler, upper surface of head, prothorax, and abdomen dark brown or black, shoulders and apex of elytra and knees more or less infuscated. With rather dense pubescence, paler on under than on upper surface.

*Head* with a wide and rather shallow fovea close to each eye, a feeble medio-basal impression, and a deep frontal one. *Antennæ* comparatively stout, first joint as long as second and third combined, second to eighth feebly decreasing in length but of even width, ninth strongly transverse and wider than eighth, tenth slightly longer and wider than ninth, eleventh ovate, almost as long as eighth to tenth combined. *Prothorax* slightly longer than wide, with a deep medio-basal impression, narrowly connected with extreme base, each side with a strong impression, somewhat dilated near base, interrupted near middle and traceable almost to apex. *Elytra* about as long as wide; with four small basal foveæ and numerous minute punctures. *Metasternum* with a wide shallow median impression. *Undersurface of abdomen* with a wide shallow impression, common to four segments. *Middle trochanters* strongly, the hind ones very feebly, armed; hind tibiae with a short, subapical spur. Length 2½-3 mm.

♀. Differs in having somewhat thinner antennæ, metasternum flat along middle, abdomen gently convex on undersurface, and legs unarmed.

*Hab.*—Tasmania: New Norfolk, in tussocks of grass (A. M. Lea).

In general appearance very close to the species described by Raffray as *P. Victoris* of King, but the male with thinner antennæ, the apical joint of which is without an oblique impression on its undersurface, abdomen without an obtuse tubercle.

towards the sides of the fourth segment, the impression shallower and different at apex, the spurs of the trochanters shorter, and the hind tibiae very different. The spurs of the hind tibiae are readily seen from most directions, but they are much smaller than in the other described species, and appear to consist of a few setae forming a small fascicle. The females are rather shorter and more compact, but otherwise much as in *P. Victoriae*. From the male of *P. mirandus* (to which it is closer) it differs in the abdomen being wider, with its impression more pronounced and apex different, the metasternum not bifoveate in front, and the hind tibiae feebly spurred.

*PALIMBOLUS FEMORALIS*, n.sp.

♂. Pale castaneous. Rather densely pubescent.

*Head* with a large shallow fovea close to each eye, with an impression from base to apex, deep at apex, fairly distinct at base, but scarcely traceable on middle. *Antennae* not very stout, first joint slightly curved, slightly longer than second and third combined, fourth to eighth of about even size and each feebly transverse, ninth larger and moderately transverse, tenth slightly larger than ninth, eleventh ovate, as long as ninth and tenth combined. *Prothorax* and *elytra* much as in the preceding species. *Metasternum* with a large semicircular fovea behind each median coxa, each fovea about two-thirds the length of the metasternum itself. Undersurface of *abdomen* with a wide shallow depression common to several segments. Four hind *trochanters* strongly dentate; front femora somewhat curved and each with a strong obtuse tooth, which is provided at apex with a thin elongate fascicle; hind tibiae with a strong acute spur at about one-fourth from apex. Length 2½ mm.

*Hab.*—Australia (T. Blackburn).

A single male, without locality, given to me years ago by the Rev. T. Blackburn as *Tyrus mirandus* Sharp; but evidently not that species, although with similar hind tibiae. The front femora, however, are very remarkable, and as a species before me (see below) agrees perfectly with Sharp's description of *T. mirandus*,



I prefer to regard that one as correctly identified. From that species it differs (besides in the front femora) in the metasternum having the basal foveæ considerably larger, the four hind trochanters more acutely armed, and the apex of abdomen somewhat different. The curvature of the basal joint of antennæ is not visible from above.

Although the type appears to be immature, it has been described, as the remarkable front femora readily distinguish it from all previously described species.

*PALIMBOLUS ELEGANS*, n.sp. (Plate xxi., fig.7).

♂. Reddish-castaneous, legs, palpi, elytra, and upper surface of abdomen somewhat paler; elytra somewhat infuscated on sides near base and apex, and on suture at apex; upper surface of abdomen feebly infuscated in places. With rather dense but somewhat unevenly distributed and more or less golden pubescence.

*Head* rather narrower than usual, strongly convex, with a shallow impression on each side near summit of convexity, with a deep impression in front. *Antennæ*, for the genus, rather thin, first joint as long as second and third combined, fifth slightly longer than fourth or sixth, eighth not transverse, ninth and tenth rather large and feebly transverse, eleventh ovate, scarcely as long as ninth and tenth combined. *Prothorax* much longer than wide, strongly convex, with a rather large but shallow medio-basal impression, each side with a continuous impression, but somewhat irregular about middle. *Elytra* at base much wider than widest part of prothorax, sides increasing in width to near apex, with fairly distinct but irregularly distributed punctures, and with several basal impressions. *Abdomen* with stronger margins than usual, those of the third segment strongly incurved; undersurface with a strong transverse fovea on fourth segment. *Pygidium* entirely ventral, with a distinct median fovea. *Metasternum* strongly convex. *Hind trochanters* strongly and acutely dentate; hind tibiæ with a short acute spur at apical third. Length  $2\frac{1}{2}$ - $2\frac{3}{4}$  mm.

♀. Differs in having head and metasternum less convex, abdomen non-foveate and with normal margins, and legs unarmed.

*Hab.*—Tasmania: Mount Wellington, in moss; Ulverstone, Frankford, Waratah(A. M. Lea).

The strongly convex head and metasternum, with the narrow prothorax of this beautiful species, are sufficient to distinguish the females from those of all other species known to me. The strong fovea on the fourth ventral segment of the male is very distinctive.

The hind tibiæ are spurred somewhat as in *P. mirandus* and *P. femoralis*, but the spur is more distant from the apex, although less distant than in the figure of *P. puncticollis*. The infuscation of parts of the elytra and abdomen is not very deep, but is readily seen.

*PALIMBOLUS FOVEICORNIS*, n.sp.

♂. Reddish-castaneous; elytra and appendages more or less flavous. Clothing rather long and moderately dense.

*Head* with three interocular foveæ, of which the median one is slightly posterior to the others, these almost touching the eyes; with a strong depression between the interantennary ridges. *Antennæ* fairly stout, extending to middle coxæ, first joint cylindrical, as long as three following combined, ninth and tenth fairly large and transverse, eleventh briefly ovate, its undersurface strongly impressed or foveate towards base. *Prothorax* with sides strongly inflated slightly in advance of middle; with three longitudinal foveæ, the median one confined to the basal third, but with a vague impression traceable from it almost to apex, the lateral ones distinct to in front of the middle; punctures rather indistinct. *Elytra* very decidedly wider than long, sides strongly dilated to apex; with four basal foveæ; punctures indistinct. *Abdomen* decidedly wider than elytra, and about twice as long; undersurface flattened along middle and scarcely impressed. *Metasternum* depressed along middle. *Hind tibiæ* with a strong subapical spur. Length  $2\frac{1}{2}$  mm.

*Hab.*—New South Wales: Sydney(H. J. Carter).

Readily distinguished from all previously described species by the conspicuous fovea on the undersurface of the eleventh joint. The impressions on the ventral segments are so feeble that from most directions they appear to be absent. The spur of the hind-tibiæ is so placed that the apex itself appears to be wide and triangularly notched. The elytra are shorter even than in *P. mirandus*. *P. armatus*, described as having shorter elytra than in *P. Victorice*, has the metasternum and abdomen very different.

*PALIMBOLUS DIMIDIATUS* Raffr.

Only the female of this very distinct species was known to Raffray.

The male has the antennæ slightly longer and more thickened at apex than in female, but with the long basal joint no longer; the prothorax wider near apex and narrower at the base; the undersurface with a strong impression from middle coxæ to apex of abdomen; a strong obtuse median tubercle on each side of impression on metasternum; an obtuse tubercle on each of the four hind trochanters; and the hind tibiæ curved, somewhat inflated and pilose about middle, and thence to apex concave; at about their apical third there is also a feeble spur, indistinct or invisible from most directions.

*Hab.*—W. Australia; Bridgetown, Swan River.

*PALIMBOLUS VICTORIE* King.

The species described by Raffray as probably *P. Victorice* is the commonest of all the larger species of *Pselaphidæ* occurring in moss in Tasmania; and the males are easily recognisable by the undersurface of the apical joint of the antennæ, four hind trochanters, abdomen and hind tibiæ. Raffray describes the hind tibiæ as "posticis intus ante apicem calcare maximo, lato, compresso et laminato armatis" and his figure (These Proceedings, 1900, Pl. x., fig. 39) agrees with this description; but the spur is not solid as it appears at first sight, and is really a compressed fascicle of setæ or hair, evenly truncated. When stuck together by gum, however, it appears really solid, no matter how examined with a pocket-lens.

## PALINBOLUS MIRANDUS Sharp.

There are three males from Victoria (Victorian Alps and Bright) before me, which appear to belong to this species, referred by Sharp, with doubt, to *Tyrus*. Sharp does not mention the front femora, but in the specimens under consideration these are fairly stout, curved, and from some directions appear concave on the lower or inner surface. The hind tibiae are spinose near the apex, the spine being at the same position as in *P. Victorie*; but of very different shape from that of that species.

## TYROMORPHUS SPECIOSUS King\* (Plate xxi., fig. 8).

♂. Dark reddish-castaneous, palpi somewhat paler. With fine pale pubescence, denser on abdomen than elsewhere.

*Head* longer than wide; with two large round interocular foveæ, and with a depression between antennary ridges; with moderately distinct punctures. Eyes very prominent. Antennæ long, first joint cylindrical, slightly longer than second and third combined, third distinctly longer than second, slightly longer than fourth and seventh, and the length of fifth and sixth, eighth short, ninth stouter and about twice as long as eighth, tenth slightly stouter and slightly shorter than ninth, eleventh elliptic-ovate, almost as long as ninth and tenth combined. Palpi rather long, first joint very short, second almost as long as third and fourth combined, its basal third thin, the apical two-thirds subelliptic, third about half the length of fourth and not much longer than wide, fourth elongate-subelliptic, not thin at the base, with an apical seta. *Prothorax* strongly convex; distinctly longer than wide; with three subbasal foveæ, a shallow one on each side, and a smaller but deeper one in middle; with dense punctures. *Elytra* strongly convex, not as long as wide, sides moderately rounded; dorsal

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\*I had the description of this species written out as new when fortunately I was enabled to examine the type (*Tyrus* of King). King's description is utterly misleading, as all he says of the third abdominal segment is "postius angulato"; and he omits any reference to the remarkable characters of the metasternum, although part of the less remarkable leg-armature is noted.

striae rather deep and wide, but terminated before middle; punctures much less distinct than on prothorax. Upper surface of abdomen with third segment slightly shorter than second, its middle strongly elevated and with a ridge tipped with short and somewhat golden setæ, fourth with a large fovea on each side of middle, the middle itself strongly raised, with the elevated part flattened at its apex and tipped with somewhat golden setæ; lower surface with third and fourth very short in middle, fifth flattened in middle, and sixth with a large median impression. *Metasternum* strongly convex; each side of middle with a strongly raised, slightly curved, truncated tubercle, with a minute tubercle half-way between its tip and the hind coxa. *Legs* long; front trochanters strongly and acutely dentate; femora moderately stout, the middle pair feebly dentate at basal third, the hind pair feebly dentate at the middle; tibiae thin and gently curved. Length 4 mm.

*Hab.*—N. S. Wales: Otford (A. M. Lea).

Readily distinguished from all other described species by its large size (it is, in fact, one of the largest of the *Pselaphidæ*) and remarkable abdomen and pygidium. I have a vague idea that the specimen described was found in a nest of ants, but unfortunately kept no record as to this.

*TYROMORPHUS QUADRIDENTATUS*, n.sp.

Bright reddish-castaneous, appendages somewhat paler, but ninth and tenth joints of antennæ and abdomen somewhat darker. Sparsely pubescent.

*Head* (excluding neck) distinctly transverse; with a puncture or very minute fovea close to each eye, and a moderately distinct interantennal depression. Eyes very conspicuous. Antennæ moderately long, first joint cylindrical and as long as second to fourth combined, second slightly longer than third, the others to eighth (which is slightly transverse) gradually diminishing in length, ninth and tenth longer and wider, eleventh subovate, as long as eighth to tenth combined. Palpi with first joint stout and short, second rather strongly curved, with apical half inflated,

third not much longer than wide, fourth rather briefly subovate and tipped with a seta. *Prothorax* almost as long as wide, widest near apex, the sides thence rather gently decreasing in width to base, with a very shallow depression on each side near base, and with a small fovea in middle near base; almost impunctate. *Elytra* distinctly wider than long, apex much wider than base and gently incurved to middle; dorsal striæ rather wide on basal slope, but then narrowed and terminated before middle; almost impunctate. Upper surface of *abdomen* with second segment increasing in width from base to apex, slightly longer than third and fourth combined, but shorter than fifth, fourth scarcely one-third the length of third; lower surface very feebly convex along middle, apical segment depressed. *Melasternum* depressed along middle. *Legs* moderately long; front trochanters and front femora strongly and acutely dentate; tibiæ moderately curved. Length 2-2½ mm.

*Hab.*—Tasmania: Huon River, in tussocks; Launceston (A. M. Lea).

In many respects close to the description of *Tyrus spinosus*, but smaller; and head and prothorax of an almost uniform shade of colour (of colour, Westwood says "*Niger*,...*capitis facie antice picea*,...*prothorace piceo*; *elytris sanguineis*"). The prothorax is not wider than the head across the eyes, but really a trifle narrower. Westwood describes the antennæ as of ordinary form, but in the figure the basal joint is drawn as stouter, shorter and much less cylindrical than in the present species, which also has a small medio-basal prothoracic impression, that is neither mentioned nor figured in *T. spinosus*. *T. nitidus* has the front legs similarly armed, but is figured and described as having the abdomen produced in the middle and the tips of the antennæ different. It is closer to *T. levis* than to any other species known to me, but the antennæ are wider, abdomen darker than head, and considerably wider than in that species.

I should have imagined the three specimens before me to be all males, but as Raffray has described the dentition of the legs in the female of *T. levis*, it is possible that they are all females.

The apical dorsal segment of the abdomen is large, rounded at apex, and produced over the pygidium, which in consequence appears to be ventral. At a casual glance, the head, prothorax, and elytra appear to be glabrous; but, on close examination, fine sparse pubescence becomes visible; the elytra also are tipped with very fine and regular pubescence. From some directions a very vague longitudinal impression can be seen between the eyes.

*TYROMORPHUS AURICOMUS*, n.sp. (Plate xxi., fig.9).

♂. Brownish-castaneous, sometimes almost piceous, appendages and part of elytra paler, palpi flavous. With moderately long pubescence on upper surface, denser on abdomen and tips of elytra than elsewhere; lower surface of abdomen with a conspicuous, more or less golden, fringe at extreme base.

*Head* distinctly transverse; with two round foveæ of moderate size slightly in advance of the eyes, and with a rather deep depression between the antennary ridges. Antennæ moderately long, first joint subcylindrical, slightly longer than second and third combined, third to eighth feebly and regularly diminishing in length, with the eighth distinctly transverse, ninth and tenth rather large and subquadrate, eleventh slightly longer than ninth and tenth combined, its apex distinctly curved. Palpi rather long, first joint very small, second almost as long as third and fourth combined, thin at base, with the apical half moderately inflated, third thin at base and regularly inflated to apex, fourth once and one-half the length of third, thin at the base, with the apical two-thirds elliptic-ovate, and tipped with a seta. *Prothorax* almost as long as wide, widest near apex, the sides thence gently decreasing in width to base; with a small deep fovea in middle near base, but without latero-basal foveæ; with small and rather sparse punctures. *Elytra* about three-fourths as long as wide, sides gently rounded, apex scarcely wider than across shoulders; dorsal striæ deep at base, and traceable to beyond the middle; with numerous rather distinct punctures. Upper surface of *abdomen* decreasing in width from base to apex, second segment longer than third, but shorter than fifth, third about once and

one-half the length of fifth; lower surface widely flattened along middle. *Metasternum* widely and gently concave in middle. *Legs* rather long; trochanters unarmed, tibiae thin, the middle pair strongly spurred at apex. Length 1½-2 mm.

♀. Differs in having somewhat shorter antennae, the joints of the club smaller, and the apical joint ovate and not incurved at its tip; ventral segments not flattened along middle, metasternum less concave, and the legs somewhat shorter, with the middle tibiae not spurred.

*Hab.*—Tasmania: Waratah, Ulverstone, Mount Wellington, Hobart (A. M. Lea).

Most of its punctures are small and inconspicuous, so that this species should probably be referred to Raffray's section of the genus "A1, Entirely smooth." At any rate the punctures are far less conspicuous than those of the other section known to me (*T. nigricornis*, *T. cribratus*, *T. Mastersi*, *T. dispar*). From the species belonging to A1, it differs from *T. laevis* and the preceding in being rather densely pubescent on the upper surface; the apical joints of the antennae are almost as figured in *T. nitidus*, but the abdomen is very different at the apex, and the legs are unarmed.

The elytra have the basal half more or less dark than the apical half, but the shades of colour are not sharply limited. One specimen has the abdomen almost black. The joints of the club are usually slighter darker than the rest of the antennae. The curvature at the apex of the eleventh joint of the male is very pronounced from some directions, and its inner portion is somewhat concave. The head is described as transverse because its upper surface is certainly wider than long; but the lower surface, in consequence of the muzzle being lengthened, is longer than wide. Many specimens were obtained from moss, and one from fallen leaves.

#### TYROMORPHUS LAEVIS Raffr.

There is before me a female (from the Tweed River), the only sex described, that was returned by M. Raffray as *T. laevis*; and as his type was originally received from me and from the Tweed River, this specimen can fairly be regarded as a cotype. In most



particulars it agrees with his description, but its head is darker than the rest of its body, and in fact is almost black; this, however, is probably an individual variation. Of the head, Raffray says:—"inter oculos foveis duabus"; on my specimen there are two minute interocular impressions. Of the prothorax he says, "fovea ante basali valida"; but, on my specimen, the fovea is decidedly small, and in other families of beetles would be regarded only as a puncture, and a rather small one at that. By an error in the table dealing with *T. laevis*, the word "antennæ" is used instead of "palpi."

Mr. Carter has sent me a male, from Sydney, that appears to belong to the species; its head is no darker than the rest of its body, and the armature of its legs is as follows:—four front trochanters dentate, the teeth of about equal length, but more acute in the front than in the middle pair; front femora each with a small acute subbasal tooth, middle femora each with an obtuse subtriangular subbasal tooth; middle tibiæ subdentate about middle, and excavated thence to apex, with the apex itself produced into a long stout spur; front tibiæ each with a strong obtuse apical spur. Its apical ventral segment is long, subtriangular, raised to apex, and with a feeble longitudinal impression.

HAMOTOPHIS AURICOMUS, n.sp.

Reddish-castaneous; suture and abdomen somewhat darker. Clothed with rather long and somewhat golden pubescence.

*Head* with dense and distinct punctures; a small deep fovea on each side, and rather closer to the eye than to each other, near middle of base with a very feeble impression, a distinct impression separating antennary ridges; a short obtuse ridge touching the lower side of each eye. *Antennæ* passing base of elytra, first joint not quite as long as second and third combined, sixth, seventh and eighth feebly transverse, ninth slightly larger and more transverse, tenth distinctly larger than ninth, eleventh much wider than tenth, and about as long as eighth to tenth combined, irregularly ovate or lopsided. Apical joint of palpi very large and highly polished. *Prothorax* slightly longer than

wide, widest across apical third, thence rapidly diminishing in width to apex, and rather feebly to base; with a distinct transverse impression at basal third, and with numerous partially concealed punctures. *Elytra* at base not much wider than prothorax at widest, but about twice the width near apex; sutural stria distinct; with four subfoveate impressions at base; punctures as on prothorax. *Under surface* with fairly numerous but more or less concealed punctures. *Legs* rather long and densely punctate; hind femora distinctly passing apex of abdomen. Length 3(vix) mm.

*Hab.*—Victoria: Hamilton (C. French).

Differs from *H. Australasicæ* in being larger, foveæ of head smaller and deeper, portion of head in front of antennæ more produced, apical joint of palpi larger, more bean-shaped and without apical seta, tenth joint of antennæ decidedly transverse and distinctly wider than ninth, legs longer (in *H. Australasicæ* the hind femora, at least in the female, terminate some distance before apex of abdomen; in the present species they distinctly pass it) and clothing (of both surfaces and legs) denser, longer and more golden. The only specimen\* before me, is of the same sex as a cotype of *H. Australasicæ*, stated by M. Raffray to be a female.

RYTUS KINGI, n.sp.

♂. Reddish-castaneous, legs and antennæ paler, tarsi and palpi almost flavous. With moderately short pale pubescence.

*Head* with a deep curved impression between eyes, each side marked by a few stiff setæ; in front of impression with a transverse ridge, and then again depressed; with distinct punctures. Antennæ rather long, passing base of prothorax, second to eighth joints subequal in length and width, ninth slightly longer and wider, tenth wider than ninth but not longer, eleventh subovate, almost as long as the three preceding combined. Palpi with first

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\*Since this was written, Mr. Kershaw, of the National Museum, sent for examination two males of this species, also from Hamilton and Mr. French's Collection. They appear to differ only in having the front trochanters each armed with a distinct and rather sharp spur.

joint concealed, second about as long as the width across eyes, basal half thin and apical half dilated, third about half the length of second, the extreme base thin but the rest as thick as the dilated part of second, fourth about the length of second, and much the same shape, except that the dilated portion is basal instead of apical. *Prothorax* strongly convex, wider than long, sides strongly rounded and widest close to apex; with a shallow fovea on each side at base; with fairly distinct punctures. *Elytra* distinctly wider than long, sides and shoulders strongly rounded; with four small basal foveæ; dorsal striæ deep at base but terminated at basal third; with numerous distinct and, for the family, rather coarse punctures. *Metasternum* with a strong, subquadrate, apical depression. *Abdomen* somewhat flattened along middle of undersurface. *Legs* long; middle trochanters acutely dentate; tibiæ moderately curved. Length  $1\frac{1}{2}$ - $1\frac{1}{2}$  mm.

♀. Differs in having the head without setæ, without the strong transverse impression, but with a shallow impression on each side behind base of antennæ, and one between them, antennæ somewhat shorter, metasternum less impressed posteriorly, abdomen not flattened along middle, and legs shorter, with the middle trochanters unarmed and the tibiæ less curved.

*Hab.*—New South Wales: National Park, Ourimbah (at both places under rotting leaves), Sydney, Otford (A. M. Lea), National Park (H. J. Carter).

The head conspicuously transversely impressed distinguishes from *R. subulatus*, and metasternum impunctate in middle instead of with comparatively coarse punctures;\* the general punctures are also smaller, although still conspicuous, and the palpi are rather stouter. In some respects close to the description of *R. corniger*, but head without "two thick setæ projecting like horns from between the antennæ." Raffray described the head of *R. porcellus* (the species he supposed to be *R. corniger*) as bearing "two strong and short brushes of yellow hairs."

\* A character omitted from the original description, but of which I can be certain, having a cotype from Dahuved.

From each side of the head the male appears to be deeply notched above the eye, with a conical tubercle in front of the notch. The fifth joint of antennæ is slightly longer than any of the three in front of or behind it, but the difference is not very pronounced.

*SCHISTODACTYLUS BREVIPENNIS*, n.sp. (Plate xxi., fig.10).

♂. Pale brownish-castaneous, appendages paler. Moderately clothed with short pale pubescence.

*Head*(excluding neck) feebly transverse, with two small and shallow interocular foveæ; with dense clearly defined punctures. Antennæ long, passing middle coxæ, first joint cylindrical, longer than second and third combined, second longer than third, the others to seventh feebly decreasing in size, eighth slightly wider, ninth slightly longer and distinctly wider than eighth, tenth slightly wider than ninth, eleventh subovate, longer than ninth and tenth combined. *Prothorax* about as long as greatest width, which is near apex, sides thence regularly decreasing in width to base; non-foveate; punctures as on head. *Elytra* very short, strongly dilated from base to apex; subsutural stria on each commencing in a feeble fovea, and regular to apex; the dorsal stria also commencing in a feeble fovea, distinct to beyond the middle, and traceable almost to apex; punctures almost as on prothorax. *Abdomen* almost twice the length of elytra, and about middle much wider; second segment largest of all; with small dense punctures; under surface feebly convex along middle, the sub-apical segment with a small fovea. *Metasternum* impressed along middle; with fairly distinct punctures. Front *trochanters* each with a long thin tooth or spine; femora stout, the front ones each with a tooth as its trochanter; tibiae thin, apex curved; tarsi with basal joint short, second much longer, third about the length of second, commencing close to its base, instead of from its apex, and terminated by two small claws. Length  $1\frac{1}{2}$ - $2\frac{1}{8}$  mm.

*Hab.*—Tasmania: New Norfolk, in tussocks; Launceston, Waratah(A. M. Lea).

Readily distinguished from *L. phantasma* by the palpi; in Raffray's figures\* the apical joint is obtuse and simple at tip, and with a long recurved spine from the middle; in the present species the apical joint is terminated by a thin spine and a fine seta, whilst the recurved spine is basal, and, as also the spine on the subapical joint, curves forward instead of backward; the two spines on the subbasal joint are unequal in length, with the longer one about the length of the one on the subapical joint. The species also differs from Raffray's description in not being glabrous, in the eleventh joint of antennæ paler than the preceding ones, or the club at least unicolorous with the rest of the antennæ, elytra with the subsutural stria regular throughout, and the dorsal one continued beyond middle.

The tarsi of this genus are very peculiar, but Raffray may have been mistaken in describing and figuring them as terminated by single claws. At any rate in the present species some of the tarsi (of the four specimens before me) appear to be each terminated by a single claw, but this is probably due to gum, as on others there are quite distinctly two very fine claws. The second joint appears to have a groove into which the third is capable of being partially received.

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#### EXPLANATION OF PLATE XXI.

- Fig. 1.—*Sagola Tasmanica* Lea.  
Fig. 2.—*Batrissodes gibbicollis* Lea.  
Fig. 3.—*Rybaxis acanthosterna* Lea.  
Fig. 4.—*R. macrocephala* Lea.  
Fig. 5.—*Otenisophus longicornis* Lea.  
Fig. 6.—*Narcodes nigriventris* Lea.  
Fig. 7.—*Pulimboldus elegans* Lea.  
Fig. 8.—*Tyromorphus speciosus* King.  
Fig. 9.—*T. auricomus* Lea.  
Fig. 10.—*Schistodactylus brevipennis* Lea.

\*Rev. d'Ent., 1863, Plate v., figs. 20-21.

## AN ADDITIONAL NOTE ON THE BIRDS OF LORD HOWE AND NORFOLK ISLANDS.

BY TOM IREDALE.

*(Communicated by A. F. Basset Hull).*

My study of the avifauna of the Kermadec Islands necessitated reference to literature dealing more especially with Norfolk and Lord Howe Islands. I have received from my friend, Mr. A. F. Basset Hull, his account of the Birds of Lord Howe and Norfolk Islands (Proc. Linn. Soc. N. S. Wales, 1909, Vol. xxxiv, pp. 636 et seq.).

As almost all the earlier accounts of these birds are contained in scarce books, I have ventured to bring them together, and offer this as an appendix to Mr. Hull's paper. Whilst so doing, I have noted some discrepancies which seem to me to point to the solution of some matters hitherto in dispute.

There is a brief reference to pigeons, parrots, parroquets, and rails in Cook's "Voyages," (Vol. ii., p. 148, 1777), in the account of the discovery of Norfolk Island. In Hunter's "Historical Account of Port Jackson" &c., 1793, Lieut. King's journal is reproduced. Regarding Norfolk Island, he writes "On our first landing we found a great number of pigeons, which were so tame that we knocked them down with sticks; but latterly they quitted the low boughs, and generally harboured about the tops of the pines. When plucked and drawn they weighed from three-quarters to one pound each. The parrots are numerous, and the ugliest bird of the kind I ever heard of; this added to the harshness of their note, makes them a very disagreeable bird. The parroquets are entirely green, except a tuft on their head. Hawks are numerous, and of two kinds, the grey and blue. . . . Quails and curlews are plentiful, but very shy. The owls, which

have very handsome plumage, make a noise like one man calling to another, and they pronounce the word 'yaho' very distinctly. . . . There are also a species of birds which burrow in the ground like rabbits, where they hatch their eggs and rear their young; they are web footed, which is rather extraordinary, and their bill is like that of other sea-fowl, but they have not the least fishy taste, and their flesh is very fine. These birds never quit their holes till sunset, from which time until midnight the air is full of them; they afforded us many fresh meals." Immediately succeeding, Captain Hunter was wrecked on Norfolk Island, and in the same work he writes(p. 181) "In the month of April we found that Mount Pitt, which is the highest ground on the Island, was during the night crowded with birds. This hill is as full of holes as any rabbit warren; in these holes at this season these birds burrow and make their nests, and as they are an aquatic bird they are, during the daytime, frequently at sea in search of food. As soon as it is dark they hover in vast flocks over the ground where their nests are. Our people(I mean seamen, marines and convicts) who are sent out in parties to provide birds for the general benefit, arrive upon the ground soon after dusk, where they light small fires which attract the attention of the birds, and they drop down out of the air as fast as the people can take them up and kill them. When they are upon the ground the length of their wings prevents their being able to rise, and until they can ascend an eminence they are unable to recover the use of their wings. For this purpose nature has provided them with a strong, sharp and hooked bill, and in their heel a sharp spur, with the assistance of which, and the strength of their bill, they have been seen to climb the stalk of a tree sufficiently high to throw themselves upon the wing. . . . They are webb-footed, and of a rusty black colour. . . . They lay but one egg, and that is full as large as a duck's egg. They were at the end of May as plentiful as if none had been caught, although for two months before there had not been less taken than from two to three thousand birds every night. Most of the females taken in May were with egg, which really fills the whole cavity

of the body, and is so heavy that I think it must fatigue the bird much in flying. This *Bird of Providence*, which I may with great propriety call it, appeared to me to resemble that seabird in England called the puffin; they had a strong fishy taste, but our keen appetites relished them very well; the eggs were excellent." As a footnote is added "For a further description, and an engraving of this bird, see the Norfolk Island Petrel in Phillip's 'Voyage,' 4to edition."

In White's "Journal of a Voyage to New South Wales" (1790) we have the discovery of Lord Howe Island chronicled, and get the following account of the birds (p. 135):—"They also found on it in great plenty a kind of fowl, resembling much the Guinea Fowl in shape and size, but widely different in colour, they being in general all white, with a red fleshy substance rising, like a cock's comb, from the head, and not unlike a piece of sealing-wax. These not being birds of flight, nor in the least wild, the sailors availing themselves of their gentleness and inability to take wing from their pursuits, easily struck them down with sticks." On p. 238 is described The White Fulica, *Fulica alba*, accompanied by a good figure.

More often quoted has been Phillip's "Voyage to Botany Bay." This was published by T. Stockdale, in 1789, and is a compilation probably edited by the publisher. These accounts differ in details from the ones I have quoted, and I believe this is due to the editing. On p. 91, regarding Norfolk Island, is written:—"The woods are inhabited by innumerable tribes of birds, many of them very gay in plumage. The most useful are pigeons, which are very numerous, and a bird not unlike the Guinea fowl, except in colour (being chiefly white), both of which were at first so tame as to suffer themselves to be taken by hand." On p. 182, where the discovery of Lord Howe Island is chronicled, is found:—"On the shore there are plenty of ganets, and a land fowl of a dusky brown colour, with a bill about four inches long, and feet like those of a chicken. . . . There are also many very large pigeons, and the white birds, resembling the Guinea fowl, which were found at Norfolk Island, were seen here also in great num-



bers. The bill of this bird is red and very strong, thick and sharp pointed." On p. 225 is given Lieut. Watts's account of the discovery of Lord Howe Island, and amongst the birds are listed "a new species, apparently, of the coote, and also of the rail." On p. 250, Captain Marshall, who called at Lord Howe Island, refers to a bird "somewhat resembling a Guinea-hen." On p. 161 is described the Norfolk Island Petrel, about which is written:—"This inhabits Norfolk Island, and burrows in the sand like a rabbit, lying hid in the holes throughout the day, and coming out of evenings in quest of food. This bird appears to differ so very little from the *dark grey Petrel* of Cook's "Voyage," (Vol. i., p. 258), that it is not improbable that it may prove to be the same species. This is described in the "General Synopsis of Birds," (Vol. vi., p. 399), under the name of *Grey Petrel*." A Plate is given, which suggests *Oestrelata*, though the description agrees better with *Puffinus griseus* Gm.; of this, more later. On p. 273 the White Gallinule is described as from Lord Howe Island, Norfolk Island, and other places," and is accompanied by a plate.

In Collins' "Account of the English Colony in New South Wales," (1798, p. 23), we have:—"It [Lord Howe Island] abounded with a new species of fowl, and a small brown bird, the flesh of which was very fine eating."

Much has been written about the White Gallinule, but I contend that a perusal of the preceding implies that it occurred solely on Lord Howe Island, and that the Norfolk Island habitat, introduced by the editor of Phillip's "Voyage," is erroneous. In favor of this view we have, first, Captain Cook does not notice it; Lieut. King, in Hunter's "Historical Account," does not mention it; and then Hunter himself, recording the lack of food, and the finding of the "Bird of Providence," has nothing to say regarding it. Surely it is feasible to suppose that a starving man would have had some remarks to make about it. Lieut. King gives quite a detailed account of the avifauna without a word of it; and it is worth pointing out that, when it is introduced as an inhabitant of Norfolk Island in Phillip's "Voyage," it is in a summary of King's papers. In Hill's "Lord Howe Island," (p. 8),

this is quoted as "King's despatches from Norfolk Island." I feel certain that the Norfolk Island habitat given in that place is an error, as the only other time it is referred to is later on in the same work, where obviously it is the editor's words. On the other hand, every visitor to Lord Howe Island was impressed by it and referred to it; and, though all the writers had visited Norfolk Island, they write of it as a new bird. Here again it must be observed that the discovery of Lord Howe Island was made on a trip to Norfolk Island; and thus a garbled account could easily be produced. In this way I believe that the Norfolk Island labels on some Lord Howe birds have been produced. Thus, when the name *Gallinula alba* was given to the White Gallinule of Phillip's "Voyage" by Latham (Index Ornith. ii., p. 768, 1790) the habitat is incorrectly shortened to "Norfolk Island." In the "General Synopsis, Supplement ii., (p. 327), 1802," Latham adds White's name to the synonymy, amends his description to cover White's details, yet retains "Norfolk Island" as the sole habitat. Von Pelzeln states that White's type was labelled "Norfolk Island." That bird was figured in the "Ibis" (1873, p. 295). The skin is preserved in Vienna. The only other specimen known is in the Liverpool Museum. Rowley, in the "Ornithological Miscellany" (Vol. i., p. 37, 1875), figures the latter as *Porphyrio stanleyi*, and gives a good historical account of the White Gallinule. H. O. Forbes (Bull. Liverpool Museum, Vol. ii., 1901, p. 62) has re-examined the Liverpool specimen, and asserts its identity with the Vienna bird. In that paper some statements are made which seem incompatible with the habitat of Lord Howe Island. The history to me seems incomplete, but Forbes accepts the statement that it was "brought by Sir J. Banks," "New Zealand rare," and consequently it must have reached this country in June, 1771. I doubt this, and find confirmation in Forbes' own words:—"Unlike most of the birds brought home by Captain Cook it was not mummified;" and later, "It is evident its pose was modelled from the Plate of the White Gallinule drawn by Miss Stone for White's Journal published in 1790." This suggests that the data, "brought by Sir J. Banks"

are incorrect; and, from the evidence I have put forward, that the bird was confined to Lord Howe Island. In "Extinct Birds" (1907, p.143), Rothschild separates the two birds, calling the Liverpool bird *Notornis stanleyi* Rowley, and identifying it with the White Gallinule of Phillip's "Voyage," restricting it to Lord Howe Island; the Vienna specimen he recognises as *Notornis alba* White, and assumes that it lived only on Norfolk Island, as White gave no locality. But I have quoted the text of White's "Journal," where he gives an account of it on Lord Howe Island, so that it would seem White's bird came from that locality, though afterwards labelled "Norfolk Island." I conclude that, upon the preceding reports, the only habitat to be assigned to the White Gallinule is Lord Howe Island, and, therefore, *Fulica alba* White, *Gallinula alba* Latham, and *Porphyrio stanleyi* Rowley, are synonymous. Reference to the Watling drawings seems to support this view. No. 258 is of a totally white bird, and Watling wrote "one-third its natural size. This bird is of Howe Island, and when young is entirely black, from that to a blueish grey, and from that to an entire white. This bird feeds itself with its feet like a Parrot," and later he added "White Gallinule complete, Latham Syn. Suppt. 2, p.327." No. 259 was first described by Watling as "Three stages of this Bird taken at Lord Howes Island before it arrives to maturity," and later is added "Three changes of the White Gallinule, Latham, Syn. Suppt. 2, p.327." Here is figured a blackish bird, a blackish bird with the breast blue, and a pure white bird. It will be noted that the only habitat given is Lord Howe Island. These figures prejudiced Latham to the view that the white birds were probably only albinos of the Purple Gallinule, but a consideration of the literature altogether discredits that conclusion.

The Watling drawings also provide the solution of the identity of the Norfolk Island Petrel. No. 280 represents a Puffinus; the legs and feet are yellowish-green, the claws black, the bill is blackish at the tip, otherwise yellowish-green or horn-colour. Watling, when he drew it, wrote "Norfolk Island. The Mutton-bird, in full feather." Later he added between "Norfolk Island"

and "The Mutton-bird" the words "Petrel or," and at the bottom, "Norfolk Island Petrel, Phillip's Voyages, pl. 10, p.161, Latham Syn. 2, p.334." No. 281 is a drawing of a similar bird with all the breast and abdomen covered with grey down; Watling's original note reads "Norfolk Island Mutton Bird in second or middle state." Here again is inserted "Petrel or" between "Norfolk Island" and "Mutton Bird," and there is added "Norfolk Island or Fuliginous Petrel a Young Bird, Latham Syn. Suppt 2, p.334. No. 282 is of a bird with a black bill and feet, and suggests *Oestrelata* rather than *Puffinus*; it is obviously not the same as the two preceding, and just as clearly the same as the Petrel figured in Phillip's "Voyage," where, however, the legs are differently coloured and described. Watling originally wrote "A Norfolk Island Bird." Later he added "Fuliginous Petrel, Latham, Syn. Suppt. 2, p.334;" but that species appears on p.333, and is *Majaqueus aequinoctialis* Linné.

The history and identification of the Watling drawings will be found in the "History of the Collections of Natural History in the British Museum" (Vol. ii, 1906). As preface to the drawings, is a "Catalogue of Drawings of Birds, referring to my General Synopsis of Birds," and above this heading is a note "N.B. This Catalogue was wrote by Dr. Latham, author of the General Synopsis of Birds." Of this note Dr. Sharpe says, "probably in the handwriting of Mr. James Lee himself"; but it is certainly Watling's. Every letter agrees with the writing on the drawings correctly assigned to Watling, as evidenced by his signature.

In this Catalogue appears "280-1-2, Norfolk Island Petrel. Sup.2,334," showing that Latham confused the *Puffinus* and *Oestrelata*. Of 280, Dr. Sharpe wrote(p.152) "This figure is in my opinion intended to represent *Puffinus chlororhynchus* Less., to which it bears a very strong resemblance. If I am correct in this supposition, the 'Norfolk Island Petrel' of Latham cannot be referred to the *Oestrelata neglecta* Schl., as has been suggested in the Catalogue of Birds (xxv., p.412)." In making this suggestion, Dr. Sharpe has overlooked the description where the tail

is stated to be "rounded." This divorces it from *P. chlororhynchus* Less., and suggests *P. griseus* Gm., which is emphasised by the description and figuration of the coloration of the soft parts. To clinch this argument, we have the fact that *Puffinus griseus* Gm., still breeds about the typical locality.

No. 282, Dr. Sharpe would identify with *P. tenuirostris* Temm., but it is undoubtedly a figure of the *Oestrelata* still breeding on Norfolk Island. Here again we have the fact that *Puffinus tenuirostris* Temm., does not breed on Norfolk Island, whilst there is an *Oestrelata* agreeing well with the figure. The conflicting accounts of the early writers are now easily reconciled. To *Oestrelata* sp., may be assigned "they have not the least fishy taste, and their flesh is very fine. These birds never quit their holes till sunset," given by King; whilst Hunter's account of the method of catching would apply better to *P. griseus* Gm.; and his report of their climbing habits might refer to *Oestrelata* sp.; the size of the egg and the strong fishy taste are more applicable to *P. griseus* Gm. The time of breeding is noteworthy. Mr. Hull (p. 649) notes the Lord Howe Island Petrel as breeding in July-August, whilst the Norfolk Island Petrel is said to breed in January (North, "Nests and Eggs," p. 416). As *Puffinus griseus* Gm., breeds at Norfolk Island in December, further investigation is necessary to clear up this point. One thing is, however, certain, and that is that the *Oestrelata* that burrows on Norfolk Island must bear the name *Oestrelata philipi* Gray, and it is not identical with *Oe. neglecta* Schl. Whether the Lord Howe burrowing *Oestrelata* is identical with the Norfolk Island species, I cannot say. Hunter's comparison with the puffin of England refers to the *Puffinus puffinus* Linné, which was called by Edwards (1764) "the puffin of the Isle of Man"; obviously, he had *Puffinus griseus* Gm., in his mind. In the Tab. Enc. Méth. i. (p. 75, 1791), under *P. grisea*, Bonaterre gives a translation of Phillip's account of the Norfolk Island Petrel. That account was probably prepared by Latham, as those of most of the other birds were, and it is copied almost word for word in Latham's works.

Mr. Hull notes that a paper on the Birds of Norfolk Island, by A. von Pelzelu, in the Sitzungs. Kaiserl. Akad. Wissen. Wien, (xli., pp.319-332, 1860) is not available in Sydney. A short summary may therefore be acceptable. Twenty-one species are recorded, the majority names only. These are :—

*Astur approximans* Vig. & Horsf., *Climacteris scandens* Temm., *Zosterops tenuirostris* Gould, *Zosterops albogularis* Gould, *Gerygone modesta*, n.sp., (p.320), *Turdus poliocephalus* Lath., *Rhipidura assimilis*, n.sp., (p.320), *Pachycephala longirostris* Gould, *Campephaga longicaudata*, n.sp., (p.321), *Aplonis obscurus* Dubus, *Nestor norfolcensis*, n.sp., (p.322, Plate of head), *Hemiphaga spudicea* Lath., *Leucosarcia picata* Lath., *Charadrius xanthocheilus* Wagler, *Limosa baueri* Natterer, *Totanus glottis* Linné, *Notornis* (?) *alba* White, *Anas superciliosa* Gmel., *Puffinus chlororhynchus* Less., *Procellaria atlantica* Gould, *Phaethon phœnicurus* Gmel.

The name *assimilis* given to the *Rhipidura* was changed to *pelzelni* by Gray. (Ibis, 1862, p.226) on account of a prior use of the name *assimilis*. *Campephaga longicaudata* Pelzelu, is a synonym of *Diaphoropterus leucopygius* Gould. The figure given of the head of *Nestor norfolcensis* is obviously that of a deformed bird; and, as the extreme variability of species of that genus is well known, the name seems superfluous. However, Rothschild has advanced the theory that it may have been a native of Lord Howe Island; he observes that it seems quite unlikely that different species should be represented on Phillip and Norfolk Islands. In favor of this view we have mention in Lieut. Watts's account of "parrots" as well as parrots when Lord Howe Island was discovered. Though Mr. Hull gives Norfolk Island alone as the habitat of the extinct *Hemiphaga spudicea* Lath., it is obvious that it was formerly as common on Lord Howe Island.

When putting together these notes, I observed records of some birds which have escaped Mr. Hull's notice. In the Records of the Australian Museum (Vol. v., p.126, 1904), North has written "Another collection of birds made by Mr. Waite on Lord Howe Island in December, 1902, contains two species that have not previously been recorded from that Island, viz., *Tringa subar-*

*quata* Guldst., and *Puffinus carneipes* Gould. A specimen of the latter was also obtained by Mr. E. H. Saunders, on the same Island, as far back as 1887." In the "Monograph of Petrels," (Pl. ii., p. 142, 1908) is written of *P. carneipes* Gould, "Mr. Ernest Saunders procured specimens on Norfolk Island and Lord Howe Island"; and, on p. 144, "The specimen described is in the British Museum, and was obtained by Mr. Ernest Saunders on Norfolk Island." It would be interesting to learn whether this Petrel breeds on either of these groups, or whether the birds recorded were simply stragglers.

In the Catalogue of Birds, British Museum, xxiv., p. 352, under *Numenius cyanopus* Vieill., appears "Lord Howe Island, Sep. 8. J. Macgillivray." As on p. 364, under *Numenius variegatus* Scop., it is recorded that Macgillivray also collected that species, there can be no doubt of the accuracy of the occurrence. *N. cyanopus* should, therefore, be added to the list.

Another species, *Megalestris antarctica* Less., is mentioned in the same Catalogue (Vol. xxv, p. 321): immature skin, Norfolk Island, F. M. Rayner, Esq.

# FURTHER NOTES ON THE BIRDS OF LORD HOWE AND NORFOLK ISLANDS.

BY A. F. BASSET HULL, SYDNEY.

(Plates xxii.-xxv.)

The very interesting contribution by Mr. Tom Iredale, on the early records relative to the avifauna of Lord Howe and Norfolk Islands, appears to settle finally the question as to the latter Island being also the habitat of the extinct *Notornis alba*. I had already arrived at the same conclusion, and, in my previous paper,\* I assigned Lord Howe Island as the only habitat of this species.

The references in the early literature to birds of the Petrel group, however, need very careful study; and much remains to be done in the way of investigation to arrive at definite conclusions regarding the identity of the species mentioned by King, Hunter, and other writers.

I have fortunately been able to establish the Lord Howe Petrel as a distinct and new species, but there are certain conflicting accounts as to the Norfolk Island Petrels yet to be reconciled. Owing to the varying seasons at which the different species breed, and to the fact that I was only a few weeks on the Island during October and November, I was unable to make personal investigations, and have had to rely upon the statements of other observers, and the examination of eggs furnished to me by residents, for some of my conclusions.

The most puzzling species undoubtedly is the *Oestrelata* (*Oe. philipi* Gray), which has been classed in the British Museum Catalogue and by later authorities with *Oe. neglecta* Schlegel. I

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\* Proc. Linn. Soc. N. S. Wales, 1909, Vol. xxxiv., p.646.



have already expressed the opinion that this classification is erroneous, my reasons being (1) Dr. Metcalfe's statement that it deposits its single egg at the end of a burrow in the sandy soil, and (2) the dimensions of the egg as given by North, viz.,  $2.14 \times 1.62$  inches.† Both of these particulars, to my mind, effectually remove *Oe. phillipi* from *Oe. neglecta*. The latter species never under any circumstances uses a burrow for breeding purposes, and the dimensions of its eggs average  $2.48 \times 1.77$  inches. Dr. Metcalfe obtained two specimens of the Norfolk Island bird, one of which, I believe, was forwarded to Dr. Crowfoot. If the present whereabouts of either or both skins could be ascertained and an examination made, I feel sure that the question would be set at rest.

Captain Hunter's "Bird of Providence" is at present a mystery. I ascended Mount Pitt, and saw no signs of occupation by any burrowing bird (November); and my collector at Norfolk Island carefully examined the locality early in August of this year, but found no signs of either birds or burrows. Captain Hunter's party found a species of Petrel present on Mount Pitt in immense numbers in May, during which month most of the females were "with egg." If this species bred there now, there would be signs of recent occupation and probably immature birds in August. Apparently, however, the insatiable demands of the convicts resulted either in the complete extermination of the colony or in its removal to some more secure breeding ground. There appears little doubt that this bird belonged to the genus *Oestrelata*. It might have been *Oe. phillipi* Gray, or (a suggestion that I put forward with some hesitation) identical with the species now breeding on Lord Howe Island. The colour "rusty black" assigned by Captain Hunter is not an exact description of the latter species, but the other particulars are applicable.

I hope at some future date to procure more information as to the extent to which *Puffinus griseus* breeds on Norfolk Island. At present the only data are Sir Walter Buller's expression of

† North, "Nests and Eggs," (1st Ed.) p. 416.

opinion that Dr. Crowfoot's *P. sphenurus* (*chlororhynchus*) is *P. griseus*; and some eggs procured for me by a collector in December, which are certainly not those of *P. chlororhynchus*, but agree with the dimensions of those of *P. griseus*.

OESTRELATA MONTANA, n.sp.

Lord Howe Petrel.

General colour above slate, feathers of the back broadly margined with darker, shafts darker; feathers of the crown of the head brown, each with a narrow subterminal grey band; forehead brown, the *sides* of the feathers broadly margined with white; lores, feathers brown, wholly margined with white; throat slaty-grey, visible bases of the feathers white, producing a mottled appearance; cheeks and sides of head brown, under surface ashy-brown, darker on the neck and abdomen, lower neck feathers broadly margined with paler shade; bases of all the body-feathers pure white; wing-coverts, primaries brown, faintly margined with grey; secondaries brighter brown, margined with lighter; primaries with quills black, except at the extreme base, where they shade gradually to white; outer webs black; inner web next to the quill blackish-grey, then shading from white at the base and for half the length of the feather to greyish-black at the tip; secondaries slate, quills black; outer web faintly margined at apical end with pale grey, inner web greyish-white at base, blackish along quill extending diagonally to the edge of the feather, which is faintly margined with white; under wing-coverts slate, bases and margins of feathers white; rump and upper tail-coverts slate, margined with darker, becoming less dark and succeeded by a narrow white outer edge; outer tail-feathers dark slate, quills brown, basal half of inner web with narrow margin extending to apical end of outer web white; central tail-feathers almost uniform slaty-brown, with white bases, narrow edge and tips white; bill black; tarsi and first joint of inner toe horn-colour. Total length 17.6 in., wing 11.6, tail 5.45, bill 1.37, tarsus 1.68, middle toe and claw 2.45; wing extends 0.75 in. beyond the tail.

In my previous paper on "The Birds of Lord Howe and Norfolk Islands," I gave a brief description of a specimen of this bird procured by Messrs. Hedley and McCulloch, of the Australian Museum, and Mr. W. S. Dun, from Mount Gower, Lord Howe Island. I then expressed the opinion that it was a species distinct from *Oe. neglecta* Schlegel, with which it had been identified by Mr. North.

I have since procured another adult skin, and a series of eggs, taken on 3rd June, 1910, in the same locality by Mr. Herbert Wilson, who also furnished me with some interesting particulars regarding the habits of the bird.

A comparison with a skin of *Oe. neglecta* supplied to me by Mr. W. R. Brook Oliver (one of the Kermadec Island expedition) shows that the difference is very marked indeed. In fact, *Oe. montana* does not closely resemble any other of the thirty-two known species of the genus. It is one of the largest and most robust, and in its nature differs from the others, which are gentle and timid.

It is somewhat remarkable that this bird, locally so well known as the "Big Hill Mutton Bird," has not hitherto been described. Although it breeds only on Mount Gower, that mountain is by no means difficult of access to persons of ordinary strength and activity; indeed, several ladies have successfully negotiated the climb to the summit. A photograph of the mountain (Plate xxii.) renders a detailed description unnecessary. It is 2,840 feet in height, and the ocean front consists of a series of precipices, with steep slopes at the foot of each, covered with cliff debris, boulders, and matted cutting-grass. One of these slopes, known as the "Lower Road" (Pl. xxiii.), about 300 feet above sea-level, was the locality from which my bird and eggs were taken, but breeding places are found right up to the plateau at the top of the mountain.

In his account of the expedition to obtain specimens for me, Mr. Wilson states that the locality was very rocky, with a few patches of cutting-grass. The nests examined were all in burrows, some as much as six feet in length, and mostly constructed where the ground was wet. No nest was found in the

open, but plenty existed under the overhanging boulders in inaccessible positions. The nest was a large accumulation of cutting-grass, in which the egg was almost concealed. All the burrows examined had two outlets (See Plates xxiv., and xxv). Mr. Wilson says "the birds would stop and fight for a while. They can bite harder than any bird I have ever robbed. I have got some of the marks on my hands yet (12th July)." He located the sitting birds by calling out, when the birds gave an answering cry from their burrows. He saw no variation whatever in the colouring of the plumage of the birds seen, but some were slightly smaller than others. One bird only occupied the burrow, the mate being at sea. One egg only is laid for a sitting, as in the case of all other members of the Petrel family. Those procured are mostly stout oval in form, some being more pointed than others; colour soft dull white, with large, shallow, irregular pittings. The dimensions of eight specimens obtained by Mr. Wilson are as follows:— (a)  $2.6 \times 1.9$ , (b)  $2.6 \times 1.86$ , (c)  $2.55 \times 1.92$ , (d)  $2.55 \times 1.87$ , (e)  $2.5 \times 1.96$ , (f)  $2.5 \times 1.88$ , (g)  $2.44 \times 1.9$ , (h)  $2.4 \times 1.9$ . Average dimensions,  $2.52 \times 1.9$ . The average dimensions of nine eggs of *Oz. neglecta*, from the Kermadec Islands, are  $2.48 \times 1.77$ .

#### EXPLANATION OF PLATES XXII.-XXV.

##### Plate xxii.

Mounts Gower and Lidgebird, Lord Howe Island. (Photo by A. F. Basset Hull).

##### Plate xxiii.

The Lower Road, Mount Gower, a breeding-place of *Oestrelata montana*. (Photo by A. R. McCulloch).

##### Plate xxiv.

*Oestrelata montana*, adult at entrance to burrow under overhanging rock, Mount Gower. (Photo by A. R. McCulloch).

##### Plate xxv.

*Oestrelata montana*, nestling taken from nest, and placed above entrance to burrow; Mount Gower. (Photo by A. R. McCulloch).

## NOTES FROM THE BOTANIC GARDENS, SYDNEY.

No.16.

BY J. H. MAIDEN AND E. BRETHER.

## TILIACEÆ.

*ELÆOCARPUS HOLOPETALUS* F.v.M.

Guy Fawkes(J. L. Boorman; December, 1909).

Common in the southern parts of New South Wales, but not recorded from north of the Blue Mountains, so far as we know. Mr. Boorman writes that it is fairly common at Guy Fawkes. It attains a height of 30 to 40 feet near the coast, at the foot of the ranges, and dwindles down to a handsome shrub of 3 to 6 feet at the summit of the ranges around Guy Fawkes, Armidale district.

## RUTACEÆ.

*ZIERIA ROBUSTA*, n.sp.

East of Mt. Werong, 3,700 feet high, on the edge of "The Big Plain" overlooking the Kowmung River(R. H. Cambage, No.2281; October, 1909).

An erect compact shrub with erect branches, about 12-18 inches high, quite glabrous and densely covered with glandular tubercles very prominent on the young shoots and petioles. Leaves opposite, trifoliate, the common petiole about  $\frac{1}{4}$  inch long; leaflets obovate, about  $\frac{1}{2}$  inch long, generally with a minute recurved point and with slightly irregularly crenate margins, the glands chiefly prominent on the midrib. Flowers small, white, almost concealed amongst the leaves, in short trichotomous cymes about as long as the leaves, with small bracts. Calyx-lobes triangular, densely tomentose inside, perianth imbricate in the bud, minutely puberulent about twice as long as the calyx, the whole

flower hardly above  $\frac{1}{8}$  inch long. Anthers obtuse, not apiculate. Fruits not seen.

Frutex erectus compactusque, 12-18" altus, glaber et glandulosus tuberculis dense tectus. Foliis trifoliatis, foliolis obovatis 5-7 mm. longis, petiolo communi circiter 5 mm. longo. Floribus minutissimis in trichotomis cymis parvis, bracteis circiter æque longis quam foliis et sæpe fere obscuratis sub foliis, toto flore vix 4 mm. longo. Calycis lobis tomentosis, antheris non apiculatis. Fructus non vidimus.

The new species can hardly be said to be closely allied to any described species; its chief characteristic is its robust habit, more like an *Eriostemon* than a *Zieria*. It comes perhaps nearest *Z. cytisoides* and *Z. obcordata*, but it differs essentially from both in the inflorescence and the absence of hairs; the tubercular glands it has in common with *Z. granulata* and some forms of *Z. Smithii*, but hardly anything else, except the generic characters.

*ASTEROLASIA CORREIFOLIA* Benth., var. *MUELLERI* F.v.M.

(*A. Muelleri* Benth.).

Mt. Lindsay, Nandewar Range (R. H. Cambage; November, 1909).

The most northern locality recorded. It was recorded from Victoria alone till the first New South Wales specimen was collected, in 1900, at Lobb's Hole, in the Tumut district. The second New South Wales locality brings its range to several hundred miles further north.

*PEREHALIUM NOTTII* F.v.M.

Upper Copmanhurst (J. L. Boornian; October, 1909).

Originally described from Queensland specimens, but recorded by us, in 1898, as a New South Wales plant, from specimens collected in the Harvey Range, near Peak Hill. The Copmanhurst specimens have generally six or seven petals and calyx-lobes; and are also, in other respects, closer to the typical Queensland specimens than to those from the Harvey Range. They grow in rough sandstone country, at an altitude of 1000 or 2000 feet, and are about  $2\frac{1}{2}$  to 3 feet high.

## LEGUMINOSÆ.

*PHASEOLUS TRUXILLENIS* H. B., & K. New for New South Wales.

Gloucester(W. Heron; February, 1910); Copmanhurst(Rev. H. M. R. Rupp; February, 1910).

Previously recorded, in Australia, only from Queensland and North Australia. It is undoubtedly wild in New South Wales, and not merely a garden-escape. The Rev. H. M. R. Rupp writes:—"It is quite common in this district, and is known here as 'Shell Pea,' yet one does not very often notice it, for it seems to be a shy bloomer. It is a beautiful thing when well out. It always occurs in open or lightly timbered country." Mr. Heron also replied that he found it about 13 miles north-east of Gloucester, far removed from all habitations.

*PULTENÆA SETULOSA* Benth. New for New South Wales.

Mt. Lindsay, Nandewar Range(R. H. Cambage; November, 1909).

Previously recorded only from Queensland. Broad Sound is the only locality given in Benthian's "Flora Australiensis" and in Bailey's "Queensland Flora." The New South Wales specimens are erect shrubs, about 4 feet high, growing at an altitude of from 4,500 to 4,700 feet, and seem to differ from the type only in the less conspicuous setæ on the stipules, the character from which the specific name *setulosa* is derived.

*PULTENÆA FOLIOLOSA* A. Cunn. New for Queensland.

Texas, Queensland(J. L. Boorman; September, 1910). The most northern locality of a plant common on the New England Tableland in New South Wales, but not previously recorded from Queensland.

*EUTAXIA EMPETRIFOLIA* Schlecht. New for Queensland.

Inglewood, Queensland(J. L. Boorman; September, 1910).

The species is common in Southern New South Wales and Victoria, but has not previously been recorded from Queensland, and not even from Northern New South Wales, as far as we know.

The Queensland specimens are, in aspect, very different from the divaricate, thorny-branched shrubs of the Wyong district in New South Wales, for example; and differ from Bentham's description in the glabrous ovary, but in no other essential character. Some may regard it as a distinct species, but Bentham includes such a variety of forms in *Eutaxia empetrifolia*, that we feel justified in including also this form under that name.

*CROTALARIA JUNCEA* Linn. New for New South Wales.

Gordon Brook, Upper Copmanhurst (Rev. H. M. R. Rupp; April, 1910).

A common East Indian species, and a well-known fibre-plant. Previously recorded in Australia only from Queensland and North Australia. The Rev. H. M. R. Rupp writes:—"The only place where I have seen it, is on the south side of the Clarence, almost directly opposite Gordon Brook homestead; it grows there freely, reaching 2 feet 6 inches or 3 feet, but mostly shorter."

*JACKSONIA SCOPARIA* R.Br., var. *GONOCLEADA*, n. var.

Nambucca Heads, on stony ridges overlooking the ocean (J. L. Boorman; June, 1910).

An erect shrub, 4 to 6 feet high, very densely branched towards the summit. Branchlets angular and narrowly winged, about  $\frac{1}{8}$  inch broad, grey from a minute hoary pubescence. Flowers from pale to orange-yellow.

The shrub looks very different from the ordinary form of *J. scoparia*, but does not differ in any essential floral characters. It flowers apparently much more scantily, and the flowers are on shorter pedicels, but the shape, proportionate length and indumentum of calyx, petals, stipes, ovary and style are identical, and, therefore, we do not feel justified in separating it specifically from *J. scoparia*. The flattened branchlets approach *J. Clarkii* F.v.M., but that species is distinguished from *J. scoparia* by essential floral characters. We have not seen fruits.



**COMPOSITÆ.**

**HELICHRYSUM CASSINOIDES** Benth.    New for New South Wales.

Gunnedah(J. L. Boorman; November, 1910).

Previously recorded from Queensland only, "Keppel Bay and Broad Sound"(collected by Robert Brown); also from "Gainsford"(collected by E. Bowman, Nat. Herb., Melbourne).

It is a shrub, generally 4 to 6 feet high, exceptionally attaining a height of 10 feet or more; and was found in stony places, near the Black Jack Coal Mine, at Gunnedah.

**STYLIDIEÆ.**

**LEVENHOOKIA DUBIA** Sond.

Hawkesbury Agricultural College, Richmond; plentiful in a paddock on the College Farm(C. T. Musson; October, 1903).

New for the County of Cumberland; not recorded in Rev. Dr. Woolls' "Plants indigenous in the Neighbourhood of Sydney."

**EPACRIDÆ.**

**EPACRIS MUCRONULATA** R.Br.

In these Proceedings for 1898(Vol. xxiii., p.13) we recorded the above species as new for New South Wales. Prof. Ewart has pointed out to us that he has determined the plant as *E. paludosa*, R. Br., and we consider that his view is the correct one. It is an alpine form of *E. paludosa*, different in appearance from the form so common on the Blue Mountains, but still not specifically different. We, therefore, withdraw the name of *Epacris mucronulata* from the flora of New South Wales.

**LABIATÆ.**

**WESTRINGIA CHERLII**, n.sp.

Road from Goonoo to Mudgee(J. L. Boorman; October, 1908).

A thickly branched, pale green shrub, 4 to 5 feet high and nearly as broad, nearly glabrous but with a minute hoary tomentum on the young shoots, distinctly visible on the contracted internodes on the tops of the branches. Leaves almost sessile in

whorls of 3, oblong-elliptical to lanceolate, acute, about  $\frac{1}{4}$  inch long, the margins thickened and slightly recurved, glabrous when full grown, slightly hoary-tomentose on the underside when young. Flowers rather small, the corolla hardly above twice as long as the calyx, of a purplish-blue or sometimes white faintly tinted with pink, axillary, but all crowded at the ends of the branches, forming leafy terminal heads. Calyx green and glabrous, nearly  $\frac{1}{4}$  inch long, with a ribbed tube and short, broad but acute lobes hardly  $\frac{1}{4}$  the length of the tube, the bracts under the calyx very small. Corolla slightly hairy inside and outside; other floral characters those of the genus. Ripe fruits not seen.

Frutex densus circiter vel plus 1 m. altus, fere glaber præter tomentum minutissimum ramis juvenilibus et latere inferiore foliis juvenilibus. Foliis fere sessilibus, ternis, oblongo-ellipticis vel lanceolatis, acutis, circiter 5 mm. longis, marginibus densatis et aliquanto recurvatis. Floribus axillaribus sed apice ramorum confertis in capitibus fere terminalibus. Calyce viridi glabro, bracteis minutissimis sub apice, tubulo costato circiter 4 mm. longo, lobis latis acutisque circiter 1 mm longis. Corolla aliquanto pilosa.

The shrub grows abundantly and gregariously on slightly elevated ridges on the plains between Goonoo and Mudgee. It is not an attractive plant from an horticultural point of view; the flowers are not very conspicuous, and the foliage is of a dull pale green, often shading to purplish on the young shoots, according to the collector's notes.

Bentham writes in the "Flora Australiensis," in a footnote to the genus :—"With the exception of *W. cephalantha*, the species are so closely allied, and run so much into each other as to render it exceedingly difficult to assign to them any tangible characters." We find this remark very true, and it is difficult, for that reason, to say to which of the described species our new species is most nearly allied. It has the short calyx-lobes and very short bracts of *W. rigida* R.Br., and has also the whorls in 3's in common with that species, but it differs from it in the glabrous calyx, and widely in habit and inflorescence. In habit and inflorescence

it comes nearest to the Tasmanian *W. rubiaefolia* R.Br., but differs from it in the short calyx-lobes and in the shape, arrangement and the colour of the leaves. It cannot be tacked on as a variety to any described species, as it is as much distinguished from any of them as they are from each other. The chief characteristic is the inflorescence, which comes nearest to the capitate inflorescence of *W. cephalantha* F.v.M., without being truly capitate.

We name the plant in honour of Mr. Edwin Cheel, a co-worker on the Australian flora. Mr. Cheel also diagnosed this plant and we made use of his notes to some extent in this paper.

#### PROSTANTHERA LEICHHARDTII Benth.

Cobar (E. C. Andrews; November, 1910).

Previously recorded from Queensland only, "Bottle Tree Creek, Leichhardt," being the only locality recorded by Benthams, and later still by Bailey.

The specimen was determined by Archdeacon Haviland, and presented to the National Herbarium by the collector.

#### MONIMIACEÆ.

##### PALMERIA SCANDENS F.v.M.

Coff's Harbour (J. L. Boorman; May, 1909); Acacia Creek, Macpherson Range (W. Dunn; May, 1909, and May, 1910).

The fruits of this tall woody climber are incorrectly described; the drupes are supposed to be completely enclosed in the enlarged somewhat fleshy fruiting calyx. This is not the case in the fully matured fruits, as the fruiting specimens from the above two localities show. The fruiting calyx finally bursts irregularly, and expands into a flat, very much lacerated disk bearing 2 to 6 sessile dark drupes on its surface, much as in *Tetrastynandra* (Kibara Endl.), only the disk is much larger and more conspicuous, and the drupes are smaller.

#### LAURACEÆ.

##### CRYPTOCARYA ERYTHROXYLON Maiden & Batches.

Gloucester district (W. Heron; November, 1909).

The species was described in Maiden's "Forest Flora of New South Wales," Part xxvii., No. 96, Plate 100(1907), from specimens collected on the Macpherson Range. It is a tall tree in the northern locality, attaining 4 feet in diameter, but seems to be much smaller in the Gloucester district. This new locality extends its range several hundred miles. Mr. Heron writes:—"It is scarce here, and is about 12 inches at most in diameter, and up to 20 feet high."

### PROTEACEÆ.

EMBOTHRIUM WICKHAMII F.v.M., var. PINNATA, n.var.

Dorrigo(J. L. Boorman; December, 1909).

This interesting Proteaceous tree is common in North Queensland, on the Bellenden-Ker Range and on the Barron River, but has not been found in Southern Queensland, as far as we know; and now it turns up again in Northern New South Wales, in a very restricted area, in a different form. Mr. Boorman informs us that he did not see more than about a dozen trees in a radius of 12 miles of the Dorrigo township, and that it seems not to grow anywhere else in the district. It is a true brush-tree, growing in company with *Araucaria*, *Dysoxylon*, *Harpullia*, etc., attaining a height of 60 to 80 feet, by about 5 feet diameter. The flowers and fruits are quite identical with the Bellenden-Ker specimens, but the leaves are pinnate in the New South Wales specimens, and simple in the Queensland ones. Such a sharp distinction would justify us in giving it a new name if it belonged to any other Family, but the variability of the leaves is so marvellous in Proteaceæ, that we can only regard it as a pinnate-leaved form. The leaves are from 9 to 18 inches long, including the slender petiole, pinnate with 7 to 9 leaflets; leaflets lanceolate, generally 4 to 5 inches long, and  $\frac{3}{4}$  to 1 inch broad in the middle, tapering at both ends, pinnately obliquely veined, only the principal veins conspicuous. The rhachis between the leaflets is in most leaves slightly winged towards the top, frequently uniting the three uppermost leaflets at the base, and thus showing a tendency to relapse into a pinnatifid leaf. This tendency is dis-

tinctly shown in the floral leaves; the first leaves below the inflorescence are frequently simple, next to the simple leaf follows occasionally a leaf cleft to or nearly to the rhachis into two lobes, and then follow, generally abruptly, the pinnate leaves.

Mr. Boorman distinguishes two forms growing together in the same restricted area; one is the tall tree described above, the other is a small shrubby form 10 to 15 feet high, with considerably smaller leaves, and a greater tendency to simple or lobed leaves. The specimens look very distinct, but this is again merely an instance of the protean character of Proteaceæ; the small form will eventually grow out into the tall form, and only tall old trees seem to have the large pinnate leaves. The tree is of special interest because it is one of the few links which connect the flora of Australia with that of South America.

#### HYDROCHARITACEÆ.

*THALASSIA HEMPRICHII*(Ehrenb.) Aschers. New for Australia.

Murray Island, Torres Straits(Charles Hedley; September, 1907; and J. S. Bruce; June, 1910).

Previously recorded from the Indian and Pacific Oceans, from the Red Sea to the shores of New Caledonia and New Britain (Neu Pommern).

In these Proceedings for 1909(Vol. xxxiv., p.585) we published a note on the fruit of a marine plant doubtfully referred to *Cymodocea ciliata*. This is the plant in question; the better specimens received through the goodness of Mr. J. S. Bruce, of Murray Island, by the kind intermediary of Mr. Hedley, enable us to correct the mistake. We regret that, by an oversight, the mark of interrogation was omitted on the Plate on which the fruit is figured as *Cymodocea*, though the query was not omitted from the note.

Together with the specimens of *Thalassia*, Mr. Bruce sent excellent fruiting specimens of *Enhalus Koenigii* Rich.,(*Enhalus acoroides* Steud.) a genus closely allied to *Thalassia*, but distinguished from it chiefly by the long stalks of the fruits, which ripen on the surface of the water. Both genera seem to be

equally common in Torres Straits. Mr. Bruce sends us the following note about their distribution:—"No. 2 (*Enhalus Koenigii*) is recognised by the natives here as the true food of the Dugong; it very seldom crops the leaves of the other (*Thalassia Hemprichii*). Both plants are found only in small patches around the Murray Group, consequently Dugong is scarce; but at the islands to the west of here, where the Dugong is plentiful, both plants are found in profusion."

#### CYPERACEÆ.

TRICOSTULARIA PAUCIFLORA Benth. New for New South Wales.

La Perouse (W. Forsyth; November, 1899); Leura, Blue Mountains (A. A. Hamilton; December, 1909).

Previously recorded from Victoria only. The specimens were presented by Mr. A. A. Hamilton, and determined by him.

#### LIPOCARPHA MICROCEPHALA R.Br.

Hawkesbury Agricultural College, Richmond, in a ditch where used to be a swampy tract of country (W. Greenwood, through C. T. Musson; April, 1910).

New for the County of Cumberland. The Rev. Dr. Woolls selected the boundaries of the County of Cumberland as the boundaries of his Census of the "Plants indigenous to the Neighbourhood of Sydney," and this plant is not included in his list.

#### GRAMINEÆ.

##### PANICUM SEMIALATUM R.Br., var. LATIFOLIUM, n. var.

Duaringa, viâ Rockhampton, Queensland (J. H. Maiden; March, 1909).

A slender grass, 15-18 inches high, apparently annual. Leaves short, flat, above  $\frac{1}{2}$  inch broad at the base and less than 2 inches long, tapering to a point, hirsute and ciliate as well as the long leaf-sheaths and the stems. Stems slender, leafy at the base, with a few short distant leaves higher up. Spikelets in rather distant pairs on the panicle-branches, the second glume smooth and shining.

This slender grass looks very distinct from the robust typical *P. semialatum*, with long narrow leaves and spikelets crowded on the panicle-branches, but it has the chief characters of that species, i.e., the densely fringed second glume, and the cleft palea of the third glume. The absence of the nerves on the second glume is caused by the different texture of the glume; the nerves can be seen also in this variety, if one looks through the glume against the light.

A remarkable form of the typical robust *Panicum semialatum*, with broad marginal wings on the second glume of the spikelets, has been collected by Mr. J. E. Hadley, at Warialda, N.S.W., in April, 1908, but the character is too inconstant for a distinct variety. Normal plants and plants with winged glumes grow side by side in the locality, and in other specimens spikelets with winged glumes and spikelets, or with unwinged glumes are mixed in all proportions. This character is not mentioned by Benthani, in the "Flora Australiensis," and we propose to amend his description so as to include the Warialda form.

Bentham writes (Vol. vii., p.472):—"Glumes . . . . . the 2nd the largest, membranous, 5-nerved, fringed on each side with long pale or dark coloured hairs connected at the base on the intramarginal nerve; 3rd glume . . . . . with a small palea."

To the description of the 2nd glume should be added:—occasionally winged by a horizontally striate wing fully  $\frac{1}{2}$  line broad, and densely ciliate; and in the description of the 3rd glume it should be mentioned that the palea is deeply cleft.

*Panicum semialatum* is also an Asiatic grass, and a form, very closely resembling the Warialda form, is figured by Griffith in his "Icones Plantarum Asiaticarum" (Vol. iii., t.145), under the name *Panicum viaticum*. The second glume in the Asiatic form is broadly winged, as in the Warialda form; the sole difference is that the wing is present only in the lower three-quarters or four-fifths part of the glume, leaving the margins of its upper part bare.

Unfortunately Griffith published no description of his *P. viaticum*, and we have no means of knowing whether he deliberately

separated his species from *P. semialatum*, which was published about 40 years previously, on account of the broad wing on the second glume, or whether R. Brown's grass was unknown to him.

Sir J. D. Hooker mentions the grass in the "Flora of British India," under the name of *Axonopus semialatus*; but, though he quotes *Panicum viaticum* Griff. as a synonym, he describes the margins of the second glume as "villous," and not as winged. In his Key to the genera of Indian grasses, he separates *Axonopus* from *Panicum* on account of the "broadly fimbriate marginal nerves of the second glume and the deeply cleft palea of the third glume," laying special stress on the cleft palea (see Hooker's remark on the genus *Axonopus*, Fl. Br. Ind. vii., p.64).

The small cleft palea is present in all Australian specimens we have examined, but Bentham omits to mention the character.

F. M. Bailey adopts the name *Axonopus semialatus* Hook., in his "Queensland Flora," but also describes the second glume as "fringed on each side," without mentioning winged glumes; it seems that the form with winged glumes has not been observed in Australia, so far, in any other locality except Warialda.

#### FILICES.

**POLYPODIUM CUCULLATUM** Nees et Bl. New for Australia.

Herberton district, Queensland (R. F. Waller; 1908).

This curious little fern has a great range, from Ceylon over the Malayan Archipelago, the Philippines, Samoa, Fiji, New Caledonia, &c., but it has not been previously recorded from Australia. Mr. Waller writes: "found growing on rocks at one place only, on the Dividing Range between Evelyn Scrub and coastal waters."

**POLYPODIUM WALLERI**, sp. nov.

Herberton District, Queensland; at an altitude of about 3,500 feet (R. F. Waller; 1909).

A small tufted epiphytic fern, glabrous except the broad linear-lanceolate pale brown scales at the base of the very short stipes. Fronds 1 to rarely 2 inches long, the largest somewhat above  $\frac{1}{2}$



inch broad, lanceolate in outline, cut down nearly to the rhachis into erecto-patent entire or indistinctly lobulate blunt lobes with slightly recurved margins, the lower shortened gradually into the undulately winged short stipes, the upper ones shortened into an undulately lobed blunt point. Veinlets simple or forked, concealed amidst the almost herbaceous texture. Sori orbicular, superficial or very slightly sunk into the tissue, comparatively large, 3 or 4 on the longest lobes, solitary on the short ones.

*Filix parva*, pallide virens, glaber præter squamas lineari lanceolatas basi stipitis brevissimi. Fronsibus lanceolatis 1-2" longis et circiter  $\frac{1}{2}$ " latis, pinnatisectis fere ad rhachem in lobis lineari-obtusis, marginibus leviter recurvatis; lobis inferioribus in rhachi undulate alato contractis, lobis superioribus in apice undulato contractis. Venis simplicibus in textura fere herbacea occultis; soris orbicularibus, superficialiis, 3 v. 4 in lobis brevibus.

This interesting small fern is so closely allied to *Polypodium sarmentosum* Brackr., from the Sandwich Islands, that it may perhaps be looked upon by some as a small form of it, but the union would be rather forced. Besides the great difference in size, the Queensland fern differs from it in the very short stipes, in the more herbaceous texture, in the slightly less deeply cut-down lobes, and in the recurved margins of the lobes. Its position in the Australian flora is next to *P. blechnoides* Hook., and *P. fusco-pilosum* Baker & F.v.M.

#### ASPLENIUM AMÆNUM Presl.    New for Australia.

Evelyn Scrub, near Herberton, N.Q., on rocks (R. F. Waller; October, 1908).

This fern was originally described by C. B. Presl, in the year 1836, in his "Tentamen Pteridographiæ," but it has since been united with *A. unilaterale* Lam., (*A. rosectum* Smith, in Hooker & Baker's "Synopsis Filicum"). The Queensland fern is so very distinct from *A. unilaterale*, that we are unable to follow C. Christensen and Alderfelt van Rosenburgh in uniting the two species; but rather follow R. Schlechter, who keeps *A. amœnum* as a distinct species in his "Beiträge zur Kenntniss der

Flora von Neu-Kaledonien," in Engler's Bot. Jahrbücher (Vol. xxxix., p.8, 1907). We have not seen Presl's description of *A. amœnum*; his "Tentamen Pteridographiæ" seems not to be in Sydney, and we must rely on the correctness of Dr. Schlechter's determination. Waller's Queensland specimens are quite identical with Schlechter's New Caledonian ones, and are very distinct from the Australian form of *A. unilaterale* figured and described by Mr. F. M. Bailey from Queensland, as *A. resectum* var. *australienæ*.

We give here a short description of *A. amœnum* drawn up from Mr. Waller's Queensland specimens, and Dr. Schlechter's New Caledonian ones:—

A tufted glabrous fern with simply pinnate fronds mostly below one foot high, including the slender stipes, and 2 to 4½ inches broad at the base, gradually narrowed towards the top, mostly bulbiferous near the apex. Pinnæ lanceolate, unequal-sided, the upper side broadly cuneate at the base, the lower side narrowly cuneate and sometimes slightly cut away, bluntly toothed or lobed on both sides, the incisions shallow towards the point of the pinnæ, deeper near the base and cut down on the upper side, nearly or quite to the rachis in the lowest one or two pairs of pinnæ, leaving thus a single pinnule on the base of the lowest pinnæ of the larger fronds. Texture thinly coriaceous. Veins very oblique, forked. Sori in an irregular line on each side of the midrib, the indusium opening towards the midrib.

#### ASPLENIUM NORMALE Dou. New for Australia.

Evelyn Scrub, near Herberton, N. Queensland; on rocks and dead logs (R. F. Waller; 1909).

A fern with a wide geographical distribution, recorded in van Rosenburgh's "Malayan Ferns from Malacca, Sumatra, Celebes, Philippines, China, North India and Hawaii." The Australian specimens are much smaller than the Indian specimens (figured in Beddome's "Ferns of Southern India." t. cxxxiii.), but they agree well with the smaller forms from the Philippine Islands, though

they are still smaller, the largest Australian specimen seen not exceeding 6 inches.

*HYMENOPHYLLUM WALLERI*, sp. nov.

Evelyn Scrub, near Herberton, North Queensland (R. F. Waller; November, 1908).

Rhizome filiform, sparingly hairy with somewhat rufous scaly hairs. Stipes slender, very sparingly scaly-hairy or naked when old, not winged or very narrowly so in the uppermost part, about  $\frac{1}{2}$  to  $\frac{3}{4}$  inch long. Fronds dark-green, ovate, about  $1\frac{1}{2}$  inch long and 1 inch broad, sometimes narrower in the sterile fronds, cut down to the narrowly winged rhachis into 5-7 pinnae on each side. Pinnae spreading, the lower ones sometimes almost horizontally, ovate to ovate-lanceolate in outline and overlapping each other, pinnately lobed rather above half-way to the midrib, the lobes shallowly lobed again; ultimate lobes short and broad, rounded and with quite entire margins. Sori not numerous, terminal on the upper lobes of the uppermost pinnae; indusium almost orbicular, about one line long and at least as broad, the valves entire or with slightly uneven margins. Receptacle included.

Rhizoma filiforme; stipes gracilis vix apice alatus, 7-10 mm. longus. Frondes ovatae circiter  $3\frac{1}{2}$  cm. latae, pinnatae 5-7 laciniis utroque latere; laciniis latis, lobis pinnatis et rursus lobatis; lobis ultimis brevibus, latis, rotundatis, margine integro. Sori in lacinulis lacinarum apicalium terminales; indusio orbiculari, circiter 2 mm. longo latoque, margine integro; receptaculo incluso.

The chief characteristic of the new fern is the small frond with a fringe of sori on the top; as far as seen, the sori seem to be strictly confined to the top of the fronds. It is not closely allied to any of the described Australian species but comes very near to *H. paniculiflorum* Pr., figured in Van den Bosch's "*Hymenophyllaceae Javanicae*," t. xxxiv. The chief point of difference between the two ferns is that the indusium is twice as long as broad in the Java fern, and at least as broad as long in our new species; and the fronds are also broader in our fern, and the primary pinnae are less deeply cut-down.

## WEDNESDAY, NOVEMBER 30TH, 1910

The Ordinary Monthly Meeting of the Society was held in the Linnean Hall, Ithaca Road, Elizabeth Bay, on Wednesday evening, November 26th 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

Dr. RONALD HAMLYN HARRIS, F.R.M.S., F.Z.S., Queensland Museum, Brisbane, was elected an Ordinary Member of the Society.

Candidates for Fellowships were reminded that the 30th inst. was the last day for receiving applications.

The President gave notice of a SPECIAL GENERAL MEETING, to be held at 4 p.m., on Wednesday, 21st December, 1910, in the Board Room, Public Library, immediately before the Council Meeting on that date. *Business*: to elect an Auditor for the forthcoming audit, *vice* Mr. F. H. Rayment, F.C.P.A., who is eligible for re-election; and who is recommended, by the Council, for election (in accordance with the provisions of Rule xvi.).

The Donations and Exchanges received since the previous Monthly Meeting (October 26th, 1910), amounting to 10 Vols., 70 Parts or Nos., 45 Bulletins, 5 Reports and 31 Pamphlets, and one Map, received from 56 Societies, &c., and one Individual, were laid upon the table.

## NOTES AND EXHIBITS.

Mr. Basset Hull exhibited skins of *Fregatta grallaria* Vieill., and *Oestrelata montana* Hull, obtained at Lord Howe Island, in October of this year, by Mr. T. Harvey Johnston. The former constitutes a first record of this species from the locality; but, as the specimen was picked up dead on the beach after a gale, its discovery is not of value as indicating the possible breeding ground of the species. The *Oestrelata* is a nearly full-grown nestling, and has some of the down still adhering to the feathers on the abdomen. The colour of the true feathers is a rather deeper shade of slate than that of the adult bird (type) exhibited at the August meeting. The specimen was taken from a typical nesting burrow at the top of Mount Gower, on 17th October.

Mr. R. T. Baker exhibited specimens showing various stages in the utilisation of Tickera-fibre, from botanical specimens of *Posidonia australis* to cloth-material of various shades, manufactured at Huddersfield. Also photographs showing a dredge, hopper, and washer used in reclaiming the fibre from the shores of Spencer's Gulf, S.A., where the industry has been successfully established.

Mr. T. H. Johnston exhibited (1) an hydatid cyst (*Echinococcus polymorphus* Dies.) from the lung of a goat (collected by Dr. T. L. Bancroft in Queensland); and (2) portion of the small intestine of a kangaroo, *Macropus giganteus* Zimm., showing the presence of *Coccidium* sp. (collected by Mr. O. S. Le Souëf at Coonamble, N. S. Wales). Neither of the above parasites had been previously recorded from these hosts in Australia.

Mr. Fred Turner exhibited and made observations on (1) *Panicum glabrum* Gaud., (syn. *Paspalum ambiguum* DC.) from the upper Tweed River, New South Wales. Mr. Turner was

the first to discover this Indian grass in Australia (Vaucluse, 1904); since then Mr. F. M. Bailey, F.L.S., had recorded it from Southern Queensland (1906); the exhibitor from Rose Bay, near Sydney, and several places on the banks of the Parramatta River as far as the Ryde Bridge; and Mr. A. A. Hamilton quite recently from Leura, Blue Mountains. It spreads very rapidly in favourable situations, is an excellent pasture grass which horses and cattle eat readily and on which they appear to do well, and is a good grass for making a lawn. (2) A fasciated growth of *Lepidium rudemale* Linn., found growing on the bank of the Macquarie River, near Warren, New South Wales, a condition not previously met with in this species. (3) *Crotalaria Cunninghamii* R.Br., one of the most interesting species of the genus; a very rare plant in New South Wales, found only in the far west. The specimen shown was grown by Mr. G. W. Wiggins, of Leichhardt, from seed gathered in West Australia.

Mr. E. Cheel exhibited specimens of a fungus, *Cronartium jacksoniae* P. Henn., on branches of *Jacksonia Sternbergiana* Hueg., from Cottesloe, near Perth, W.A. (Dr. J. Burton Cleland; August, 1908); and on (?) *Lotus villosa* Sm., Cronulla (Miss Carole; October, 1910). This fungus had not been recorded previously either from West Australia or from New South Wales. Mr. Cheel reported that he had succeeded in bringing about the development of the teleutospores of *Puccinia tasmanica* Diet., by infecting the common groundsel with æcidiospores.

Mr. W. M. Carne showed some extraordinary cases of floral proliferation in specimens of a species of Teasel (*Dipsacus*), from the Hawkesbury Agricultural College garden.

On behalf of Mr. H. Burrell, the President exhibited a photograph of a marine mollusc (*Cymbium*) in the act of ovipositing.

## THE PERMANENCY OF THE CHARACTERS OF THE BACTERIA OF THE *BAC. COLI*-GROUP.

BY R. GREGG-SMITH, D.Sc., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

In a paper upon the Bacterial Flora of Rachitic Stools,\* a table was given showing the cultural characters of certain Gram-negative bacteria of the *Bac. coli*-group. These differed more or less from one another and, from the gradual variations, the opinion was expressed that further cultivation might bring about such alterations as to reduce the number of races.

Certain of the bacteria were cultivated upon artificial media for over seven months, and occasionally examined during the period of cultivation. Many of the characters were found to be permanent, while a few proved to have been only temporary. The alterations applied to what may be called the negative characters, and it was evident that with some of the bacteria the absence of fermentative activity was only transient.

A reference to the table in the former paper (p.38), will assist in explaining the relation of the bacteria with the restored characters, to the others. Twelve bacteria were under observation; these were the first twelve that were obtained in the former research.

The characters of  $B_1$ ,  $B_6$ ,  $B_{13}$  and  $B_{19}$  were permanent, and the changes in the others were as follows:—

*Motility:*  $B_4$  and  $B_{12}$  became motile.

*Growth on gelatin:*  $B_2$ ,  $B_4$  and  $B_{15}$  finally grew as a flat expansion.

*Neutral-red:*  $B_{18}$  developed a fluorescence under anaërobic conditions.

*Dextrose and Mannit:* The characters were permanent.

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\* *Antea*, p.36.

*Lactose:* B<sub>16</sub> finally produced acid and gas.

*Milk:* B<sub>14</sub> and B<sub>15</sub> ultimately produced acid and clot; B<sub>14</sub> produced acid.

*Saccharose:* B<sub>7</sub>, B<sub>14</sub>, B<sub>15</sub> and B<sub>16</sub> produced acid and gas, while B<sub>18</sub> developed acid.

Thus the races originally twelve in number were reduced to eight.

Summing these changes together, it becomes obvious that the bacterial activity towards dextrose and mannit is the most permanent of all the characters; then come the actions upon lactose and neutral-red, next the motility, followed by the action upon milk, and the growth upon gelatin; and finally, the most easily restored character is the fermentation of saccharose.



## CONTRIBUTIONS TO OUR KNOWLEDGE OF SOIL-FERTILITY. I.

### THE ACTION OF WAX-SOLVENTS AND THE PRESENCE OF THERMOLABILE BACTERIOTOXINS IN SOIL.

BY R. GREIG-SMITH, D.Sc., MACLEAY BACTERIOLOGIST TO THE SOCIETY.

It has been known, since 1894, that soil after treatment with carbon bisulphide, produces a greater crop than it would otherwise have done. Girard used the disinfectant to kill nematodes, and noted an increase of crop; Oberlin applied it in order to destroy Phylloxera on grape-vines, and saw an enhanced productiveness. Other investigators confirmed the fertilising action of carbon bisulphide, and showed that chloroform, ether, benzene and toluene gave similar results. It had also been previously known (Frank, 1888; Leibschner, 1893) that heating the soil, as for example, while sterilising it by steam, increased the solubility or availability of the mineral and organic matter. The beneficial effect of either of these treatments was manifest over two seasons, but did not extend to the third crop. Furthermore, from the dark green colour of the foliage it was evident that the treatment brought to the plant an accession of nitrogen, that is to say, the crop behaved as if the soil had been treated with a nitrogenous manure.

Investigation indicated that the increased fertility was connected with an increased activity of the soil-bacteria. There is something in untreated soils which keeps the number of bacteria at a constant level, which naturally depends upon the quality of the soil. Treatment with carbon bisulphide or with heat reduces the number, by killing off the less resistant bacteria. After the partial sterilisation, the more resistant bacteria increase,

and the number soon rises above the former level. There is, in consequence, a greater breaking down of the organic matter, and more of the simpler manurial constituents are available for the crop. Heat undoubtedly causes some chemical decomposition, for the matter soluble in water is increased.

The most suggestive explanation is, that the partial sterilisation removes a number of microbes which are of little use economically, and which compete for the food-supply with the more useful kinds. With the former out of the way, the latter increase in numbers, and their activity would account for the increase of crop. But the removal of the inactive bacteria does not explain the increase in the number of the bacteria over the normal. Russell, working in conjunction with Hutchinson, suggests that the reason for the absence of increase in the bacterial content of a normal soil, is that the protozoa and amœbæ, which occur in soils, are phagocytes and consume the bacteria. The partial sterilisation disturbs the balance which formally existed between the phagocytes and their prey, and, in the absence of the protozoa, the bacteria are enabled to increase.

If the soil is considered as consisting of a solution of nutritive matter and of soil-fragments, there is reason to expect the presence of bacterial toxins. When bacteria are added to a nutritive medium, they increase up to a maximum, and are then slowly destroyed by the accumulation of their excreted products. To all intents and purposes, these products are toxins. Many cells survive, but the majority are destroyed, and this is just what we find in soil. But in the soil there may be many toxins, as there are many classes of bacteria. If some of the bacteria are destroyed, as, for example, by heat, the remainder, on account of the freedom from competition, will multiply up to a certain limit, for the pre-existing toxin will keep the numbers down. Should, however, the toxin be also destroyed, the road is cleared for the bacteria to equal, and then to exceed the original number of those previously existing in the soil.

Whitney and others had an hypothesis that the soil-toxins were derived from plants, and were destroyed by fertilisers and by

fallowing; but more recently they consider\* that the toxins arise from the action of bacteria upon the residues left by the crop in the field-soil.

Believing that, in the soil, there are bacterial toxins, and that much had yet to be discovered concerning them, and also that the importance of the protozoal hypothesis had been exaggerated, I began this work upon soils.

By the use of soil-extracts filtered through porcelain, I have found that bacteriotoxins are normally present in soils, and that these either kill off or restrict the growth of bacteria which had been added. The result is entirely a question of the amount of toxin, and also of the kind of bacteria. Some bacteria are more sensitive to this toxin than others. The toxin is destroyed partially or entirely by heat, by the action of aqueous solutions, in both of which the time-factor has an influence, and by the action of sunlight. The solubility of the toxin varies according to the salts present in aqueous solutions; it appears to be more soluble in solutions of magnesium sulphate, potassium sulphate, and sodium chloride than in water, in the order named.

A factor, which hitherto has been unnoticed, has a certain bearing upon questions affecting soil-fertility. This is the waxy or fatty substance present in all soils. It consists of a mixture of saponifiable and unsaponifiable bodies, and, by waterproofing the soil-particles, it limits the free solution of nutritive matter. It is undoubtedly largely derived from vegetable remains, and is probably the "matter soluble in ether" of vegetable residues. The distribution of this "agricere" is altered by the soil being treated with wax-solvents, such as the volatile disinfectants; and is more or less segregated, not only locally on the soil-particles, but also in the layers of the soil. Thus the action of the disinfectants is partially explained. The full explanation, however, is not yet evident.

Russell and Hutchinson, by excluding the presence of soil toxins, came to the conclusion that the phagocytic protozoa were

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\* Chem. Soc. London, Annual Report, 1908, p. 246.

the only agents which limited the multiplication of bacteria. They did not directly test for toxins; and, although the reasons which they bring forward\* in support of the absence of toxins sound very convincing, yet a more intimate knowledge of the behaviour of the toxins enables one to interpret their experimental results generally in a manner different from what they have done. The presence of toxin and the activity of its group-specificity cannot be ignored. Furthermore, the identity of the toxins, produced by superheating soils, with the toxins of untreated soils has not as yet even been suggested, and certainly has not been proved. The behaviour of the nitrifying bacteria towards this toxin, which is one of Russell and Hutchinson's strongest arguments against the presence of soil-toxins, cannot, therefore, be considered.

Toxin is undoubtedly present in soil, and although it may not, in ordinary or natural circumstances, be absolutely toxic, yet it is sufficiently active to make itself evident as a restrainer. The soil-nutrients accelerate the growth of bacteria, the soil-bacterio-toxins restrain their multiplication, and an equilibrium becomes established. The phagocytes doubtless play a part, assisting the toxins, and the *agricere* also assists in preventing the rapid solubility of the nutrients.

#### EXPERIMENTAL.

In the various experimental results that follow, *Bac. prodigiosa* was used to indicate the growth or otherwise of bacteria. This bacterium is easy to detect, it grows rapidly, and it belongs to the class of putrefactive bacteria which are, presumably, the active agents in soil-decomposition.

The soils were obtained from the Hawkesbury Agricultural College, from an orchard near the summit of the Kurrajong, and from the garden around the Society's House. They were generally air-dried upon arrival in the laboratory, but in many cases this was unnecessary, and in certain cases the fresh soil was used.

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\*Journ. Agric. Sci. iii.(2), 117-118.

The extracts were prepared by stirring up 200 gms. of soil in a mortar with 200 c.c. of aqueous solvent for an hour, after which the solution was filtered through paper, and then through a porcelain filter. Generally, 10 c.c. of filtered extract were pipetted into a Freudenberg flask, to which 1 c.c. of suspension of *Bac. prodigiosus* was added. This suspension was prepared by suspending a portion of a culture in sterile tap-water, and centrifugalising until approximately half of the cells had been sedimented. A portion of the supernatant fluid was removed, and diluted until 1 c.c. contained about 10,000 cells. Having once determined the number, a repetition of the same procedure will give approximately the same number. This number was employed in those experiments in which the bacterial change is calculated upon 1,000 bacteria. Where the calculation is based upon 10 bacteria, the sowings were much heavier. It was only after much work had been done, that the necessity for having weak sowings for accentuating differences in the method of treatment became apparent. On this account the earlier or preliminary work has not been recorded.

The experimental error is considerable, and no two experiments were ever done under precisely identical conditions, as can be seen from the control tests. When tested, the error varied up to 10 %, but I believe that, in some cases, it may have ranged to 20 %; and, on this account, I prefer to consider the results as simply indicating a behaviour or a condition.

The infected extract was incubated at 30°C. overnight, and, after an interval of from 19 to 24 hours, it was thoroughly shaken, and used for preparing dilutions. A capillary pipette, discharging  $\frac{1}{10}$  c.c., was employed for blowing the diluted suspensions upon plates of nutrient agar. The drops were smeared over the surfaces with curved, elongated loops of iron-wire (such as is used by florists), after which the plates were dried in the incubator at 37° for an hour, covered, inverted and incubated at 30°. Plates were also smeared immediately after infecting the extract, in order to obtain the actual number of bacteria present at the start.

In the experiments with soils, 20 gms. were moistened with 2 or 5 c.c. of suspension which was thoroughly incorporated. The infected soil, or, in some cases, sand, was incubated overnight at 30°, as in the case of the infected extracts, and, in the morning, it was shaken up with 500 c.c. of sterile water for 30 minutes; dilutions were then made. As a rule, those plates containing from 40 to 400 colonies were reserved for counting.

#### THE EFFECT OF HEAT UPON AIR-DRIED SOILS.

##### Experiment i.

Soil heated for 2 hours at

10 bacteria became  
(average of 4 soils)

22°	15
50°	56
100-108°	330

##### Experiment ii.

	10 bacteria became					
	a		b			
	one day		one day		four days	
	not heated	heated	not heated	heated	not heated	heated
Sand .....	—	—	75	—	52	—
Hawkesbury soil 1 .....	11	114	16	741	5	2
„ „ 2 .....	31	145	19	56	10	2
„ „ 3 .....	13	55	15	712	87	504
„ „ 4 .....	34	28	33	19	20	117
„ „ 5 .....	24	107	36	119	30	66
Garden soil.....	—	—	41	4015	125	650

These tests show (Expt. i.) that the increase of the bacterial activity is proportional to the temperature to which the soil has been heated, and (Expt. ii.) that soil, as compared with sand, contains some substance which prevents the rapid growth of bacteria. It is also shown that prolonged incubation may reduce the number of bacteria, presumably by the development of auto-toxins.

## THE TOXIC ACTION OF FILTERED SOIL-EXTRACTS.

## Experiment iii.

	10 bacteria became	
	one day	three days
Tap-water (control) .....	100	75
Extract of untreated soil.....	0	0
Extract of chloroformed soil.....	7,875	7,950

## Experiment iv.

	1,000 bacteria became	
	one day	two days
Extract of untreated soil.....	13	67
Extract of chloroformed soil.....	1,300,000	—

The same (Expt. iv.) untreated soil-extract was, two days afterwards, heated in boiling water. The temperature was tested several times, and found to be 94°. Portions were abstracted at intervals, infected and incubated.

## Experiment iv. a.

	1,000 bacteria became
Extract not heated .....	24,800
Extract heated 15 minutes.....	272,000
Extract heated 30 minutes.....	1,200,000
Extract heated 60 minutes.....	3,000,000
Extract heated 120 minutes ..	3,850,000
Extract heated 180 minutes ..	3,710,000

It is evident from (iii.) and (iv.) that the aqueous extract of soil, as made by treating the soil for an hour, contains a toxic substance. In two days, at laboratory temperature, the toxin has apparently disappeared; but that it has only been partly destroyed, is shown from the effect of heat in (iv. a). Two hours

heating at 94° has completely destroyed the toxin which remained in the extract.

#### THE RELATIVE VARIATION OF THE TOXIN IN SOILS.

##### Experiment v.

	1,000 bacteria became
Soil 1 extract .....	0
Soil 1 extract heated .....	36,500
Soil 4 extract .....	0
Soil 4 extract heated .....	2,000
Control (no soil).....	117,200

The soils were extracted shortly after their arrival in the laboratory, 0.2 % NaCl having been used for their extraction.

The experiment is interesting from the fact that the fertility of these two soils was widely different. No.1 was described as a "fairly rich alluvial soil," with a fertility of 8 points (10 being the maximum obtainable). No.4 was a poor sandy soil, with a fertility of 2. The poorer soil had the larger amount of toxin. Both extracts were made in precisely the same way, and at the same time (with an interval of half-an-hour between them); and, as they were heated at the same time and for the same time in test-tubes, in the same boiling water, the numbers can be taken as being relative, one to the other.

To show that the lessened growth in the heated extract of Soil 4 was due to partially destroyed toxin, and not to the absence of nutritive matter, the unheated extract was boiled, two days afterwards, and tested.

##### Experiment vi.

	1,000 bacteria became
Soil 4 extract .....	78
Soil 4 extract heated to boiling (this occupied three minutes).....	667
Soil 4 extract boiled for an hour..	3,250,000
Saline (control) .....	70,000



## THE SOLUBILITY OF TOXIN IN SALINE SOLUTIONS.

## Experiment vii.

Soil No.4.	1,000 bacteria became
Extracted with tap-water .....	30
The same extract boiled for an hour.....	2,460,000
Extracted with 0.2 % NaCl in tap-water.....	0
The same extract boiled for one hour.....	70,000
Saline tap-water (control).....	70,000

## Experiment viii.

Soil No.4.	1,000 bacteria became
Extracted with 0.5% NaCl (dist. water) .....	88
" " " $K_2SO_4$ " " boiled 1 hour .....	9,375
" " " $MgSO_4$ " " .....	0
Control (NaCl in distilled water) .....	211,000

In (vii.) it is seen that dilute saline extracts more toxin than water, while (viii.) indicates that sodium chloride falls short of potassium and magnesium sulphate. That the lessened bacterial growth was due to toxin, is shown in the following, which was made with the unheated extracts, two days later. The plates smeared at the start of the experiment were spoilt, and the numbers are based upon 250 cells being in  $\frac{1}{10}$  c.c.; this was the average of several experiments made before and after.

## Experiment ix.

	1,000 bacteria (estimated) became
$K_2SO_4$ extract	88
" " " boiled for 3 hours.	7,200,000
$MgSO_4$ extract	24
" " " boiled for 3 hours..	88,000

The result with potassium sulphate is interesting, as Baker has shown that, in the grains of cereals, there exists a toxin which is toxic to brewery-yeasts. This toxin is also thermolabile. It is, however, destroyed by potassium sulphate, and thus differs from the soil-toxin. Whitney had an hypothesis that manures, when applied to soil, simply destroy the toxins that have exuded from plants, and enable the fertilising matters naturally in the soil to assist the growth of crops. Potassium sulphate is such a manure, and, as far as we know, does not destroy the toxin.

The experiments which have been quoted, show that a bacterio-toxin is unquestionably present in soils. The various sidelights that have been thrown upon its nature, show that it is present in soils in quantity which varies with the soil, a richer soil probably containing less, a poorer soil more. It is slowly destroyed by storage in aqueous solution, and rapidly broken up by heat. It is more soluble in solutions of salts than in water, and in different saline solutions it has a different solubility. It does not appear to be of the same nature as the thermolabile toxin occurring in the grains of cereals.

#### THE PRESENCE OF AGRICERE IN SOILS.

In treating garden-soil with an excess of carbon bisulphide, it was observed that, upon the surface, a curious moss-like efflorescence appeared as the disinfectant evaporated. The colour was at first yellow, then it became greenish, then grey, and finally the efflorescence disappeared. Microscopically it consisted of branching processes recalling coral. When picked up with the blade of a knife, it melted to a brown wax-like substance. Subsequently a similar phenomenon was noted when chloroform had been employed.

Following up this observation, it was found that the disinfectants dissolve a wax, or group of wax-like bodies, which are present in the soil. The solvents appear to differ in their powers of extraction, not only in the appearance, but also in the quantity of the extract; thus petroleum-ether took out of garden-soil a brownish-yellow wax, alcohol a brown wax, and chloroform a

very dark brown substance. It is possible that the petroleum-ether dissolves waxes and fats, while the darker bodies may be resins. A mixture is to be expected from such a substance as soil, but, as the bulk is soluble in petroleum-ether, and as the substance is of a wax-like nature, I propose, for convenience' sake, to name it "agricere."

The agricere (0.39 grm.) was obtained from 500 gms. of garden-soil by means of hot chloroform, and distilled in a small retort, previous observation having shown that some of the wax could be volatilised. Several drops distilled over, varying in colour from white to brown, but about one-third of the quantity remained behind, condensing as it volatilised, while a portion charred. The wax or fat was separated from the carbon residue, and both volatile and residual fatty matters were boiled with alcoholic potash. After expulsion of the alcohol, ether extracted an unsaponifiable portion; and the liquid, after treatment with sulphuric acid, yielded brown fatty acids. The heating appeared to destroy the substances of rather high melting point, as both volatile and residual portions melted at 52°, and were identical. The unsaponifiable matter melted at 43°, and the fatty acids at 53° to 54°.

The portion of a hot alcoholic extract, insoluble in petroleum-ether, melted at 95°, and yielded a non-saponifiable portion melting at 64°, and fatty acids at 68°. The ethereal solution was lost.

Petroleum-ether dissolved an agricere melting at 73°. This gave an unsaponifiable portion, m.p. 57°, and fatty acids, m.p. 69°-70°. The former was again saponified, and yielded unsaponifiable matter, m.p. 54°-55°, and fatty acids, m.p. 57°-58°.

The agricere is evidently a complex substance, the components of which are found to differ according to the solvent used. The components appear to be of the nature of waxes or fats which yield fatty acids upon saponification, and of paraffin-like bodies which are not saponifiable.

The observation that led to the discovery of agricere, also made it evident that the solvent caused a redistribution of this sub-

stance. It was clearly brought from the soil-particles below, and deposited upon the surface. Experiments were made with a solution of agricere in chloroform, and it was found that when the chloroform was poured over fragments of unglazed porcelain, the solvent, in evaporating, left the wax upon the upper surfaces or points of the porcelain. A solution of pitch in chloroform was poured over sand contained in a watch-glass. The solvent evaporated, leaving the pitch as a black film cementing the surface-grains together. Under the film, the sand-granules were light in colour and loose. The great bulk of the pitch had been carried to the surface. Large pieces of unglazed porcelain were saturated with the pitch in chloroform, and hung up to dry. The pieces dried with black surfaces, and, when broken across, white centres were revealed.

This may be considered to be what happens when the soil is treated with a solvent. The agricere is carried to the surface of the soil-particles or to the surface of the soil, according to the quantity of solvent used. The water-proofing of the particles being destroyed, the nutritive material is dissolved by the soil-water, and is then capable of being absorbed by plants, either immediately or after its conversion into an available form by bacteria.

The following four sets of experiments have a bearing upon the redistribution and behaviour of the soil-wax. Each of the sets *a*, *b*, *c* and *d* were made upon different days, and probably had different periods of incubation. In *a* and *b* the 20 gm. tests were treated with 5 c.c. of *Bac. prodigiosus* suspension, of such concentration that there were added 6,400,000 and 8,600,000 bacteria, respectively, per gram of soil. From a general survey of the results, however, I believed that too many bacteria had been added, and that the increases were too near the maximum attainable. In *c* and *d*, therefore, a smaller number, 46,000 and 47,000, respectively, per gm., were added, in the hope of obtaining more divergent figures. The soil was a garden-soil that had been stored for about a month.

## Experiment x.a.

	10 bacteria became			
	thick sowing		thin sowing	
	a	b	c	d
1. Stored soil.....	17	20	60	45
2. Stored soil extracted with hot chloroform.....	853	700	16,300	10,000
3. No. 2 with the addition of the chloroform extract and stirred while the solvent was evaporating.....	836	468	10,870	7,020
4. Stored soil treated with cold chloroform, and stirred while the solvent was evaporating.....	444	454	--	--
5. Stored soil treated with cold chloroform, the solvent evaporating spontaneously.....	595	610	--	--

These experiments show that the complete extraction of the *agricere* enables a greater multiplication of the bacteria to take place. The stirring of the soil, while the solvent was evaporating, caused rather a better distribution of the soil-wax, but once the solvent has been added, the distribution is permanently destroyed. It appears to be a matter of indifference whether the *agricere* is completely removed, and then returned, or the soil is moistened with solvent. In both cases the wax is segregated at points upon the surface, as can be seen by the microscopic examination of grains of sand which have been treated with the chloroform solution of *agricere*.

After extracting the soil with chloroform, it was dried and exhausted with hot distilled water in the Soxhlet apparatus, and dried. The aqueous extract was made to volume, and incorporated with sand, and dried. As would be expected, the treatment favoured the growth of bacteria.

## Experiment x.b.

	10 bacteria became			
	thick sowing		thin sowing	
	a	b	c	d
6. Sand alone.....	1	4	2	8
9. Sand impregnated with aqueous extract (half strength) .....	792	893	—	30,850
Sand impregnated with aqueous extract (full strength).....	—	—	74,900	—

The residual soil, after extraction with chloroform and water, still contained a considerable amount of available nutriment.

## Experiment x.c.

	10 bacteria became			
	thick sowing		thin sowing	
	a	b	c	d
2. Stored soil exhausted with chloroform .....	853	700	16,300	10,000
10. The same exhausted with hot water .....	166	1,770	8,690	7,660

It must be remembered that, in this experiment, the garden-soil was extracted with hot chloroform for a day, and that this treatment would have been sufficient to destroy much, if not all, of the bacteriotoxin in the soil. We, therefore, have to deal with the behaviour of the toxin-free soil relative to the agricere. From the results we conclude that the removal of the inert agricere enables the nutrients to be liberated and become available for the growth of bacteria. Allowing for the action of the chloroform, the agricere, when returned to the soil, causes it to behave like a normal soil. Stirring the soil during the evaporation of the solvent diffuses the agricere, and prevents so free a liberation of the nutrients.\* These are slowly dissolved by hot water, and, even after a day's extraction, the soil contains a considerable quantity.

It has been shown that wax-solvents induce a segregation of the agricere, and enable the soil-nutrients to be dissolved in water, and made available for bacteria. There is, however, the possibility that the solvent may have an action of its own upon the soil-toxin, either in destroying it or causing its segregation. In the latter case, the increased liberation of the nutrients may counteract the depressing action of the toxin. A number of experiments have been made in this direction, and will be considered in another paper of this series.

#### THE ACTION OF SUNLIGHT.

The fertilising action of sunlight is a matter that has raised some discussion, and the general opinion is that it has a distinct effect upon the fertility of a soil. As the question appeared to be related to the destruction of toxin, two experiments were made to determine the truth of the belief. In the first, the portions of soil, a rich orchard soil from the Kurrajong, were spread out on paper in the garden. One portion was covered with black calico, the other was exposed to the sun. Both were under glass frames to prevent the soil being blown away with the wind. The extracts were made with distilled water in the usual proportion and time (200 grm., 200 c.c., 1 hour).

Experiment xi.

	1,000 bacteria became	
	a	b
	5 hours' exposure light, average 46.5° dark, average 88°	12 hours' exposure light, average 62° dark, average 42° control, average 21°
Extract of exposed soil .....	4,200	227,000
Extract of protected soil .....	7	11
Extract of protected soil, boiled 2 hours .....	429,000	—
Saline control .....	171,000	—
Extract of control soil .....	—	9

It is evident that sunlight has a strong destructive action upon the soil-toxin.

## THE ACTION OF TOXIN ON SOIL-BACTERIA.

So far, the experimental results have been obtained with *Bac. prodigiosus*, a bacterium taken for several reasons, the chief being that it is a putrefactive microbe, and it can be easily grown and detected. But the data obtained with it also apply to other soil-bacteria, although the effects are not so marked. The soil-bacteria appear to be more or less immune, for we cannot believe that the soil-toxin is specific for so rare a soil-organism as *Bac. prodigiosus*. In counting soil-bacteria, one has to prepare extreme dilutions, because, in the plates containing strong dilutions, bacteria such as *Bac. fluorescens* will prevent the growth of other soil-bacteria.

In the following experiments the extracts were made with 0.5 % NaCl and portions of the filtered extracts were seeded with portions of the unfiltered suspensions. After one day's incubation, the dilutions were prepared. The plates were incubated, in the first case for 1, 2, and 3 days; in the second case, for 2 days.

## Experiment xii. Kurrajong Soil.

Plates incubated for.....	1 day.	2 days.	3 days.
At start.....	8	22	29
After incubation for 1 day.			
Extract.....	600	2,200	2,750
Extract boiled one hour.....	90,000	160,000	225,000

## Experiment xiii. Hawkesbury Soil No.4.

## Approximate Percentage Analysis.

	Colonies.	<i>Bac. fluorescens</i> .	Large sub-titile-like colonies.	Small colonies of <i>B. bigeminus major</i> .	Other colonies.
At start .....	100	3	63	5	39
After incubation for 1 day.					
Extract .....	20,700	3	1	90	5
Extract boiled..	158,400	4	1	90	6
Saline (control)	138,000	27	10	60	3



The result shows that the toxin is toxic towards the bacteria naturally occurring in the same soils from which the extract was obtained. Although the toxic action is not so pronounced as with *Bac. prodigiosus*, yet it is active, and is destroyed by heat. The chief organism that grew in the extracts was a microbe identified as *Bac. bigeminus major*. It is remarkably inert; it does not liquefy gelatine, does not produce indol, or reduce nitrate, and does not ferment dextrose.

#### SUMMARY.

Water extracts from soil a substance which is filterable through porcelain, and which is toxic to bacteria.

The toxicity is made evident by the retardation of growth, or by the destruction of the bacteria.

The toxin is destroyed by heat, by sunlight, and by storage. It slowly disappears from air-dried soil, and rapidly decays in aqueous solution.

It is not destroyed by salts, such as sodium chloride, potassium, or magnesium sulphate.

Soils vary in the amount of toxin they contain; good soils containing less, poor soils more.

The particles of soil are covered or "waterproofed" with soil-wax or "agricere," which consists of a mixture of saponifiable and unsaponifiable bodies.

The wax-solvents (volatile disinfectants) alter the distribution of the agricere by carrying it to the surface of the soil, and causing it to be segregated on the points of the soil-particles.

With the removal of the "waterproofing," the soil-nutrients are more easily dissolved by soil-water, and attacked by bacteria.

## CARABIDÆ FROM DORRIGO, N. S. W.

BY THOMAS G. SLOANE.

The township of Dorrigo is situated in the midst of a heavy forest, about thirty miles west from the port of Coff's Harbour, on a volcanic plateau having an altitude of about 2,000 feet above sea-level. Three miles east from Dorrigo, the escarpment of the plateau descends abruptly to the low-lying land of the coast.

In July, 1910, Mr. H. J. Carter and I made a hurried entomological trip to Dorrigo, going from Coff's Harbour, viâ the Bellinger River. We were able to spend only three days (9th and 10th July, with portions of the 8th and the 11th) collecting around the township, and to do a little minor collecting *en route* at Bellingen and Raleigh. While we were at Dorrigo there was a white frost each morning.

We devoted our attention almost entirely to collecting *Carabidæ* and *Tenebrionidæ*. In the present paper, I report on the *Carabidæ* we found, together with some additional species obtained by Mr. H. W. Cox during a visit to Dorrigo, subsequent to ours, in the month of August. Mr. Carter, in an appendix, will deal with the *Tenebrionidæ*.

(1) List of *Carabidæ* found at Dorrigo and the Bellinger River : *Pamborus morbillosus* Boisd., *P. pradierei* Chaud., (Dorrigo); *P. guerini* Gory (Bellingen); *Mystropomus subcostatus* Chaud., (Dorrigo); *Clivina australasiae* Bohem., (Raleigh); *Eurylychnus regularis*, n.sp., *Meonis angusticollis*, n.sp., *Amblytelus minutus* MacI., *A. marginicollis*, n.sp., *Dystriothorax vittipennis*, n.sp., *Leirodora auricollis* Cast., *Ceratoferonia phylarchus* Sl., (Dorrigo; common, hiding in rotting logs), *Castelnaudia vigorsi* Gory, var. *alternans* Sl., (Raleigh), *C. marginifera* Chaud., *C. speciosa*, n.sp., *Notonomus angustibasis* Sl., *N. nitescens*, n.sp., (Dorrigo); *N. bellingeri*, n.sp., (Bellingen); *N. australis* Cast., var. *crenulata*, var. nov., *Notolestus sulcipennis* MacI., (Dorrigo); *Zoedera*

ater Cast., (slope of escarpment); *Protopogmus chalybeipennis* Chaud., *P. oodiformis* Macl., *Setalis niger* Cast., *Siagonyx ampli-*  
*pennis* Macl., (Dorrigo); *Lacordairia cycloides* (Raleigh); *L. sp.*?  
 (unique), *Gnathaphanus pulcher* Dej., *Gn. melanarius* Dej.,  
*Diaphoromerus iridipennis* Chaud., *D. femoralis* Cast., *Hypharpax*  
*nitens*, n.sp., *Lecanomerus major* Blkb., *L. carteri*, n.sp., *L. curtus*,  
 n.sp., *Thenarotes atriceps* Macl., *Xanthophæa grandis* Chaud.,  
*Sarothrocrepis setulosa*, n.sp., *S. suavis* Blkb., *S. blackburni*,  
 n.sp., *Coptodera australis* Chaud., *Agonochila punctulata*, n.sp.,  
*A. nucleayi*, n.sp., *Philophlæus luculentus* Newm., var. *guttifera*,  
 var. nov., *Scopodes angulicollis* Macl., (Dorrigo).

(2) Additional species from H. W. Cox:—*Epicosmus elongatus*  
 Cast., (Coff's Harbour); *Teraphis helmsi* Sl., *Dystriothorax*  
*vicinus* Blkb., (Dorrigo); *Colpodes lajertei* Montrz., (Coff's Harbour);  
*Trechus coxi*, n.sp., *Agonochila quadricollis*, n.sp., *Philophlæus*  
*intermedius* Chaud., (Dorrigo).

In all, fifty-two species, including sixteen new species, and  
 two new varieties.

#### EURYLYCHNUS REGULARIS, n.sp.

Robust, elongate, convex; head with one supraorbital seta on  
 each side; prothorax cordate; elytra oval, fully striate. Black;  
 tibiae piceous-red, tarsi piceous.

Head large (4.5 mm. across eyes), convex; vertex transversely  
 impressed on each side behind eye; frontal impressions strong,  
 curved, diverging backward; eyes round, prominent. Prothorax  
 broader than long (4.8 x 5.65 mm.), strongly narrowed to base,  
 much wider at apex than base; anterior angles wide, rounded;  
 basal angles obtuse, not marked; lateral border thick, merging  
 with surface of prothorax at basal angles; a short deep foveiform  
 basal impression connected with posterior extremity of lateral  
 channel on each side; a single marginal setigerous puncture at  
 about middle of the length on each side. Elytra convex (10.7 x  
 6.1 mm.); striæ deep, simple, four inner ones reaching base, 5-8  
 terminating successively further from base; interstices lightly  
 convex; punctures along sides widely interrupted in middle.

Prosternum bordered along anterior margin. Anterior tarsi in ♂ not clothed beneath with spongy tissue. Length 20, breadth 6.1 mm.

*Hab.*—Dorrigo; a single specimen (♂), hibernating beneath a log in the bush.

This species requires comparison only with *E. blagravei* Cast., from which it is very distinct by the prothorax more gently narrowed to base, the sides without any juxtabasal sinuosity, basal angles not prominent; elytra with interstices more even, fifth (not fourth) dilated at base (in *E. blagravei* the fourth stria joins the lateral channel at the humeral angle, but in *E. regularis* the fourth stria reaches the base considerably inwards from the humeral angle—in a similar position to the third stria in *E. blagravei*); prosternum bordered, etc.

*Note.*—The remarkable interstitial sculpture of the elytra in *E. blagravei* has not been recorded. There are only seven striae and eight interstices on the elytra, and there is no sign that the loss of one stria and interstice is caused by the eighth and ninth interstices coalescing, and so forming a double interstice, as in the case of *E. dyschirioides* Cast. (= *E. olliffi* Bates). The evidence is rather that the loss of the stria and interstice occurs on that part of the elytra between the humeral angle and the suture. I believe that, in *E. blagravei*, the two inner interstices represent the three inner interstices of a normally sculptured species like *E. regularis*; I know of no case of similar striation in the subfamily Harpalinae.

#### MEONIS ANGUSTICOLLIS, n.sp.

Elongate, convex; prothorax very little longer than broad, sides strongly sinuate posteriorly, basal angles rectangular; elytra much wider than prothorax, oval, lightly 4-striate on disc on each side of suture; fifth stria well developed on apical declivity. Black, nitid; tarsi piceous.

Head narrow (2.2 mm. across eyes), convex, strongly transversely impressed behind eyes; two supraorbital punctures on each side; front deeply bi-impressed; eyes hemispherical. Maxillae with

inner lobe not hooked at apex. Labial palpi with penultimate joint bisetose in front. Prothorax much wider than head, a trifle longer than broad ( $3.2 \times 3.15$  mm.); sides lightly rounded on anterior three-fourths, strongly sinuate near base; anterior margin truncate; anterior angles obtuse, but a little marked; base truncate, angles sharply rectangular; lateral basal impressions shallow; spaces between each lateral basal impression and lateral channel narrow, convex; two marginal setæ on each side, anterior at anterior third, posterior in lateral channel a little before basal angle. Elytra oval, convex, much wider than prothorax ( $6.1 \times 4.2$  mm.); sides rounded; base truncate; humeral angles subdentiform; apex lightly sinuate on each side; first stria very lightly impressed, not reaching base; striæ 2-4 fine but strongly impressed, fifth strongly impressed on apical declivity, becoming obsolete before reaching middle of elytra; first interstice narrow, the others wider, equal, hardly at all convex; a row of punctures along lateral channel. Length 9-12, breadth 3.2-4.2 mm.

*Hab.*—Dorrigo.

This species is readily distinguished from the other three described species of the genus, by having the prothorax less strongly rounded on the sides, lateral basal impressions much shallower; elytra with striæ much shallower, interstices hardly at all convex. Specimens of two distinct sizes occurred together at Dorrigo, in the brush; the larger 12 mm., the smaller 9 mm. in length. Four specimens are before me; of these two of the larger size and one of the smaller are females, the other specimen being a male, 9 mm. in length.

*Note.*—Having specimens of the four species of *Meonis* before me, it seems advisable to tabulate them as under:—

Elytra with disc deeply 5-striate. (Prothorax broader than long,  $3.25 \times 3.5$  mm.)..... *M. niger* Cast.

Elytra 4-striate on disc, 5-striate on apical declivity.

Striæ lightly impressed; prothorax lightly rounded on sides..... *M. angusticollis* Sl.

Striae deeply impressed; prothorax strongly rounded  
 on sides..... *M. convexus* Sl.  
 Elytra deeply 4-striate..... *M. ater* Cast.\*

AMBLYTELUS MARGINICOLLIS, n.sp.

Robust; head short, wide across occiput; prothorax broad, wider across base(1.6 mm.) than apex(1.25 mm.), lateral border very wide, flat; elytra convex, crenulate-striate, interstices a little convex, third impunctate. Testaceous; margins of prothorax, legs, and basal joint of antennae yellowish; elytra with a black mark on each, bounded externally by seventh stria, reaching apical margin, extending nearly to humeral angles on sixth and seventh interstices, becoming wider posteriorly and covering interstices 2-7 on apical declivity; first interstice reddish; the rest of the testaceous parts of the elytra yellower than head and prothorax.

Head wide(1.3 mm. across eyes); frontal impressions deep, wide, parallel; a lateral channel extending forward from above eye to base of antenna; space between each frontal impression and lateral channel narrow, convex; eyes large, convex, inclosed at base; postocular part of orbits projecting sharply, but a little obliquely, from head. Prothorax widely transverse(1.15 x 1.8 mm.), broadest about middle; sides rounded, shortly and sharply sinuate just before base; apex truncate between anterior angles, these a little advanced, widely rounded; basal angles rectangular, acute; median line lightly impressed; a well-marked impression on each side of base; posterior marginal seta on edge of border just before widest part of prothorax. Elytra ovate(4.25 x 2.7 mm.), lightly convex; apical curve lightly sinuate on each side at apex of ninth interstice; first stria lightly out-turned in a faintly marked course near base and uniting with second at point of

\* From a specimen (♂) in my Collection (received from Mr. A. M. Lea, ticketed "Tweed River, N.S.W.") in which the elytra have only four striae, the fourth as deep as the others on the disc, but becoming obsolete on the apical declivity. This specimen has the prothorax broader than long (3.7 x 4 mm.).

origin; seventh faintly marked, but distinct on sides; first interstice wide and bearing an elongate stria at base, eighth wide on sides, narrow and carinate towards apex, ninth narrow and seriate-punctate; basal border uniting with inner part of first interstice, sharply raised at humeral angles; lateral border narrow, reflexed. Apical ventral segment in ♂ 4-, in ♀ 6-setose. Length 6.6-7, breadth 2.5-2.75 mm.

*Hab.*—Dorrigo.

This species can be readily separated from the other species of the genus by the great width of the lateral borders of the prothorax. It resembles *A. discoidalis* Blkb., by the rectangular basal angles of the prothorax, and the pattern of the elytra; but differs by the postocular part of the orbits rising more sharply from the neck, prothorax more transverse, less narrowed to base, lateral borders much wider, humeral angles of elytra more prominent, etc.

*DYSTRICHTHORAX VITTIPENNIS*, n.sp.

Slightly convex; head obliquely constricted behind eyes, strongly bi-impressed between eyes; prothorax subquadrate, much wider across base (2.2 mm.) than across apex, basal angles rectangular, posterior marginal seta on border beside basal angle, anterior seta wanting; elytra finely crenulate-striate, seventh stria obsolete, interstices a little convex, third bipunctate, fifth impunctate. Nitid, testaceous; elytra more lightly coloured than head and prothorax, 4-vittate; vittæ black, inner vitta of each elytron occupying second and third interstices, outer vitta occupying seventh and eighth interstices; apex and margin testaceous.

Head (1.75 mm. across eyes) lightly transversely impressed behind vertex, obliquely and decidedly narrowed behind eyes; frontal impressions elongate, wide, parallel; vertex convex; eyes prominent, inclosed behind. Prothorax broader than long (1.7 × 2.3 mm.), broadest a little before middle, very little narrowed to base, strongly and roundly narrowed to apex; sides lightly rounded anteriorly, oblique posteriorly; apex truncate between

anterior angles, these, near neck, obtuse; base sinuate-truncate (a slight protuberance behind each lateral basal impression); lateral margin extending from neck to basal angle, wide, a little wider posteriorly; median line well marked; lateral basal impressions parallel, short, deep, wide. Elytra ovate ( $6.25 \times 3.9$  mm.), convex; base of same width between humeral angles as base of prothorax; apical curve sinuate at extremity of ninth interstice; first and second striae reaching marginal channel at apex, fourth flexuous on apical declivity and uniting with third before reaching marginal channel; first interstice narrow, widened and bearing a lightly marked elongate stria at base, seventh and eighth confluent before apical curve, divided (and eighth carinate) on apical curve, ninth narrow, seriate-punctate; basal border uniting with inner part of base of first interstice, arcuate on posterior margin; humeral angles rather sharply marked; lateral border wide on sides. Length 8.5-9.7, breadth 3.5-3.9 mm.

*Hab.*—Dorrigo. Common under bark on trunks of Eucalypts.

Belongs to the section of the genus having an elytral pattern; this section contains two other species, viz., *D. vicinus* Blkb., and *D. bicolor* Blkb.; *D. vittipennis* is at once distinguished from both by the pattern of the elytra, which resembles that of *Amblytelus curtus* Erichs. In *D. vicinus* Blkb., the sutural part of the elytra is black, except near the base, which is testaceous; and this testaceous basal area is prolonged backward, on each elytron, as a pointed vitta reaching to the beginning of the apical declivity; in *D. bicolor* the discoidal part of the elytra is testaceous, and each elytron has a wide black stripe on the side.

#### *CASTELNAUDIA SPECIOSA*, n.sp.

Closely allied to *C. nitidicollis* Cast. Head and prothorax brilliant purple; elytra opaque, dark purple, summits of costae nitid, nigro-viridescent, margins metallic-purple; undersurface black, nitid; tarsi and palpi reddish.

Elliptical. Head large (4.65 mm. across eyes), bisetose above each eye. Prothorax subcordate, broader than long (5 x 6 mm.),



not wider at base (4.2 mm.) than at apex (4.3 mm.); sides strongly sinuate on each side posteriorly; basal angles subrectangular, obtuse at summit; posterior marginal puncture near lateral margin about half a millimetre before basal angle. Elytra truncate-oval (12 × 7.4 mm.); derm shagreened; interstices 1, 3, 5 and 7 carinate; second carina (third interstice) bisetose on posterior half; spaces between carinæ depressed and with two rows of small punctures; ninth interstice seriate-punctate, hardly indicated towards apex. Prosternal and mesosternal declivities glabrous. *Posterior trochanters (especially in ♂) very broad, roundly obliquely narrowed from inner side to the obtuse apex.* Length 22, breadth 7.4 mm.

*Hab.*—Dorrigo.

Six specimens have been examined. This species is so closely allied to *C. nitidicollis*, that it could easily be mistaken for that species, unless the posterior trochanters are examined. The prothorax hardly differs; though it is a little longer, narrower, and less strongly rounded on the sides, posterior sinuosities of sides longer, posterior marginal seta more distant from base. In both sexes the posterior coxæ have the external apical angle more obtuse, and the posterior trochanters are much wider. In *C. nitidicollis* the external apical angle of the posterior coxa is, in ♂, narrow and pointed; in ♀, widely and obtusely triangular; and the posterior trochanters are, in ♂, long, narrow, obtuse at apex, compressed (lightly and widely concave) towards base; in ♀, narrower than in ♂, elongate, not compressed. The form of the penis in these two species is very different; in *C. nitidicollis* it has the apex very wide, produced laterally on each side; on outer side shortly and obtusely, on inner side strongly and sharply in a dentiform projection. In *C. speciosa* the apex is wide, and shortly produced laterally only on outer side; outer angle prominent and dentiform.

*C. nitidicollis* and *C. speciosa* are the only two species of *Castelnaudia* with any noticeable sexual difference in the form of the posterior trochanters.

*NOTONOMUS NITESCENS*, n.sp.

Oval, robust; head moderate (2.4 mm. across eyes); prothorax truncate-cordate, basal angles rectangular, posterior marginal seta on inner side of marginal channel near basal angles; elytra strongly striate, interstices convex, third bipunctate, eighth and ninth narrow, convex. Colour variable, nitid, with a more or less cupreous tinge on upper surface; prothorax polished with metallic tints, usually more or less cupreous towards sides, sometimes almost black with merely a faint viridescent tinge towards sides; elytra nitid, obscurely cupreous (rarely a bright copper-colour in ♂), eighth and ninth interstices and marginal channel sometimes more brightly coloured (cupreous) than rest of elytra, sometimes not brighter; undersurface and legs black; antennae and tarsi piceous.

Prothorax broader than long (3.2 × 3.8 mm.), broadest about middle, wider across base (3.1 mm.) than apex (2.5 mm.), depressed near base, strongly declivous to anterior angles; sides lightly rounded, obliquely narrowed to base, lightly sinuate just before basal angles; apex emarginate; anterior angles rather prominent but obtuse; base truncate on each side, lightly emarginate in middle; basal angles rectangular but obtuse at summit; border wide, reflexed, extending on each side of base to basal impressions, these elongate, deep, narrow, parallel; median line strongly impressed. Elytra truncate-oval (7.5 × 4.8 mm.), lightly convex on disc, strongly declivous on sides, widest about middle; apical curve lightly sinuate on each side; basal border a little raised above lateral border, but not very prominently so, at humeral angles; striae simple, deep; interstices convex, carinate on apical declivity, tenth short. Intercoxal declivities of prosternum and metasternum flat. Length 11-14, breadth 4.5-25 mm.

*Hab.*—Dorrigo. Common about the township of Dorrigo. The measurements given in the description are from a male 13 mm. in length.

Belongs to the group of which *N. nitidicollis* Chaud., is the type. Very closely allied to *N. nitidicollis*, but differing [from ♂ (♂ of *N. nitidicollis* unknown to me)], by more robust form;

prothorax wider across base; elytra with the interstices more convex, not opaque, humeral angles less strongly dentiform. From *N. latibasis* Sl., ♀, it differs by form more convex; elytra without green margin; interstices not opaque, more convex; apical sinuosities less developed. From *N. queenslandicus* Sl., ♂, it differs by the metallic tinge of prothorax and head; elytra not very brightly margined; form heavier, less elongate; elytra with interstices more convex, humeral angles less prominently dentiform. From *N. viridilimbatus* Cast., *N. violaceo-marginatus* MacL., and *N. melas* Sl., the prominent basal angles of the prothorax, with the sides subsinuate before them, distinguish it, apart from differences of colour. From *N. planipectus* Sl., it may be differentiated readily by the bright colour, smaller size, less elongate form, prothorax more strongly narrowed to base, apical sinuosities of elytra more feebly developed, etc.

NOTONOMUS BELLINGERI, n.sp.

♀. Elongate-oval, depressed. Prothorax subcordate, subsinuate before base, posterior marginal puncture a little before base on inner side of marginal channel; elytra deeply striate, interstices convex, third bipunctate, eighth and ninth narrow, convex, humeral angles subdentate. Intercoxal declivities of prosternum and mesosternum flat. Head and prothorax nitid, with obscure purple tinge [sometimes(♂)æneous]; elytra of a rather dull obscure purple [sometimes(♂)rather coppery]; undersurface piceous-black; legs piceous, tarsi, palpi, and antennæ reddish.

Head small as in *N. nitidicollis* (2.2 mm. across eyes). Prothorax broader than long (2.8 × 3.2 mm.), broadest before middle, depressed, lightly declivous to sides on anterior two-thirds; apex lightly emarginate, narrower (2.35 mm.) than base (2.65 mm.); anterior angles marked, obtuse; sides lightly rounded, more gently narrowed to base than to apex; base truncate; basal angles rectangular, obtuse at summit; median line strongly impressed; lateral basal impressions deep, narrow, elongate; lateral basal spaces depressed. Elytra truncate-oval (6.5 × 4 mm.), depressed on disc, lightly sinuate on each side of apex; basal border a little

raised above lateral border, but not prominent at humeral angles; striæ simple, deep; interstices convex, strongly so on posterior declivity, tenth short. Length 11·3, breadth 4 mm.

*Hab.*—Bellingen(H. J. Carter).

The specimen on which the description above is founded, occurred to Mr. H. J. Carter at a place about two miles north of the town of Bellingen, where I, also, found a second specimen(♂) only 9·6 mm. in length, and of a far more brassy colour than the type. I have thought the smaller specimen is probably of dwarfed size, and have, therefore, preferred to establish the species on the larger one. Closely allied to *N. nitidicollis* Chaud., but differing by elytra more depressed, interstices much more convex, humeral angles less strongly dentate, prothorax less strongly rounded on sides, wider at base, etc. It is also near *N. nitescens* Sl., but differs by being less nitid, narrower and more depressed, prothorax less rounded on sides, lateral border narrower near base, elytra more depressed on disc, more parallel on sides, basal border less strongly arcuate on posterior margin and less prominent at humeral angles, etc.

*NOTONOMUS AUSTRALIS* Castelnau, var. *CRENULATA*, var. nov.

Differs from var. *æneomicans* Chaud., by size smaller, form more convex, elytra much more declivous to apex, elytral striæ far more distinctly crenulate at bottom. Colour similar. Dimensions, ♂, 17 × 6·2; ♀, 19 × 6·75 mm.

*Hab.*—Dorrigo. Two specimens, in brush.

I would index the species thus:—*N. australis* Cast., = *N. æneomicans* var. A., Sloane, Revision, 1903(*Hab.*—Narrara and Ourimbah); var. *æneomicans* Chaud.(Port Stephens; H. J. Carter); var. *orenulata* Sl.

I have said(These Proceedings, 1903, p.600) that, in *N. æneomicans*, the tarsi have a single spinule on each side of the onychium beneath; a recent examination of the material now in my hands shows that, in the typical form of *N. australis* (which I consider to be identical with var. A of my Revision), these spinules are often, though not invariably, present. Of five

specimens examined, three had spinules and two were without. Eight specimens of var. *consonicans* showed none with spinules; and in var. *crenulata*, also, the onychium was glabrous.

*HYPHARPAX NITENS*, n.sp.

Robust, convex; prothorax subquadrate, posterior angles subrectangular; elytra lightly striate, humeral angles dentate, interstices depressed, second with a light stria at base, third unipunctate just behind posterior three-fourths. Nitid, but minutely shagreened; of a dark bronzy colour, submetallic on elytra; head black; prothorax black, with a faint greenish-bronzy tinge; tibiae testaceous towards base; antennae infusate, basal joint testaceous.

Head stout, convex (2.1 mm. across eyes); prothorax broader than long (2.1 x 2.5 mm.), lightly roundly narrowed to apex (2.15 mm.), very little obliquely narrowed to base (2.3 mm.); apex lightly emarginate; anterior angles rounded; basal angles decidedly marked, though obtuse at summit. Elytra truncate-oval (4.2 x 3.1 mm.); interstices depressed, narrow and convex at apex; basal border forming a short dentiform prominence at humeral angle. Posterior tarsi short. In ♂, four anterior tarsi with joints 2-4 dilatate and spongiöse beneath; first joint subtriangular, of anterior tarsi with a few squamæ beneath near apex, of middle tarsi not squamose beneath. Length 7, breadth 3.1 mm.

*Hab.*—Dorrigo.

Two specimens (♂♀) have been examined. It is allied to *H. rectangularis* Chaud., and *H. ovatus* Chaud. From *H. rectangularis* (from a Tasmanian specimen) it differs by form shorter, more convex; prothorax shorter, less deeply emarginate at apex, not subinuate on sides posteriorly, basal angles not rectangular; elytra with interstices narrower and more convex at apex; tibiae not so darkly coloured. From *H. ovatus* (as identified by me from specimens from Queanbeyan and Mulwala, N.S.W.) it differs by size larger; prothorax more rounded on sides, basal angles more marked; elytra more nitid, interstices becoming

narrow and convex at apex (they are flat in *H. ovatus*), puncture of third interstice more distant from apex, etc.

*LECANOMERUS CARTERI*, n.sp.

Elongate-oval, rather depressed; prothorax subquadrate, wide and not punctate at base, basal angles subrectangular; elytra fully striate, interstices depressed, narrower and a little convex near apex, second with a very short stria rising from a puncture at base, third impunctate about middle of length. Piceous; elytra opaque in ♀; margin obscurely ferruginous (including inflexed margins of prothorax and elytra); femora testaceous; tibiae, tarsi, antennae, and labrum more or less ferruginous.

Head ordinary (1.3 mm. across eyes). Prothorax broader than long (1.6 × 2.15), broadest about middle, much wider at base (1.85 mm.) than apex (1.5 mm.), lightly declivous on anterior part of sides, depressed across base; sides lightly arcuate, slightly (obliquely, hardly roundly) narrowed to base; apex emarginate; anterior angles marked but obtuse; base truncate, very lightly emarginate above peduncle, a little curved at each side; basal angles decidedly marked; a wide depressed impunctate basal space on each side. Elytra truncate-oval (4.5 × 3 mm.), lightly rounded on sides, lightly convex; apical curve hardly sinuate on each side; humeral angles marked, not dentate; inner humeral angles sharply marked. Length 7.8-3, breadth 2.75-3.25 mm.

*Hab.*—Dorrigo.

This species is at once distinguished from *L. verticalis* Erichs., and *L. flavocinctus*\* Blkb., by its larger size, sharper basal angles of prothorax, and the apex of the elytra far less strongly sinuate on each side. It is by these characters associated with *L. major* Blkb., and *L. minor* Blkb.; from *L. major* (to which species, amongst those described, it is most nearly allied) it may be readily

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\* *L. flavocinctus* Blkb., = *L. occidentalis* Sl. A specimen of *L. flavocinctus* was sent to me by the Rev. Thos. Blackburn, and, after comparing it with cotypes of *L. occidentalis* in my Collection, I consider them synonymous. The prothorax varies in width in my specimens from Western Australia.

differentiated by its less dark colour; elytra with light-coloured margin; ♀ with lateral interstices of elytra opaque; prothorax wider, with basal angles less sharply marked, etc. *L. minor* is very different, and may be distinguished from the other species I have examined by its much shorter metepisterna.

LECANOMERUS CURTUS, n.sp.

Stout, oval; front shortly and obliquely bi-impressed; eyes close to buccal fissure beneath; mandibles decussating; labial palpi with penultimate joint bisetose in front; prothorax subquadrate, much wider across base (1.75 mm.) than apex (1.2 mm.); elytra ovate, lightly punctate-striate, interstices depressed, third unipunctate about posterior third, striae at base of second wanting. Black, nitid (♂ and ♀); legs, antennæ, palpi and labrum (also abdomen) piceous-red; prothorax with a very narrow piceous-red margin on sides posteriorly.

Head short, stout (1.05 mm. across eyes). Prothorax broader than long (1.2 × 1.8 mm.), broadest a little before middle, hardly narrowed to base, lightly and widely convex, subdepressed towards base; apex emarginate; anterior angles obtuse but marked; sides arcuate anteriorly; lightly and roundly narrowed to apex, almost straight on posterior half; base truncate; basal angles rectangular but obtuse at summit; lateral border narrow; base impressed on each side; median line very faint. Elytra short (3.3 × 2.5 mm.) convex; base truncate, a little wider than base of prothorax; basal border strongly developed, forming a short decidedly dentiform prominence at humeral angles; apical curve lightly sinuate on each side; lateral border narrow, reflexed; striae lightly impressed (more strongly so on apical declivity), formed of rows of closely placed punctures, sixth and seventh obsolete towards base; eighth interstice convex at apex, ninth wide, seriate-punctate, the punctures widely interrupted in middle. Length 5.3, breadth 2.5 mm.

*Hab.*—Dorrigo.

A very distinct species, which can be compared only with *L. mastersi* MacI., from which it differs conspicuously by *facies*;

prothorax straight on posterior part of sides, basal angles not roundly obtuse; elytra with dentiform humeral angles and punctate striæ; four anterior tarsi in ♂ far less dilated, etc. Three specimens were found under the bark of a tree-stump blackened by fire, in a clearing near the township of Dorrigo.

*SAROTHROCREPIS SETULOSA*, n. sp.

♂. Oval; prothorax subquadrate, widest at posterior angles, these acute; sides sinuate posteriorly; elytra finely crenulate-striate, interstices depressed, covered with a distinct but sparse puncturation. Testaceous; elytra with a wide irregular post-median black fascia; tibiæ and tarsi brownish; abdomen brown towards apex.

Head ordinary (1.85 mm. across eyes); prothorax broader than long (1.75 × 2.55 mm., width near anterior marginal seta, 2.5 mm.); apex (1.65 mm.) much narrower than base, lightly emarginate; anterior angles obtuse; sides lightly and roundly narrowed anteriorly, sinuate before base; base truncate on each side, produced roundly backward in middle; basal angles triangular, acute; lateral margins explanate, widely so posteriorly; derm sparsely beset with minute setuliferous punctures. Elytra much broader than prothorax (6.6 × 4.5 mm.); base truncate with humeral angles obtuse; striæ finely and lightly impressed, minutely crenulate; interstices shagreened, sparsely beset with distinct small setigerous punctures. Length 10, breadth 4.5 mm.

*Hab.*—Dorrigo.

Resembling *S. corticalis* Fabr., in pattern; but differing by prothorax much narrower, sides more sinuate posteriorly, basal angles much more prominent and acute; elytra with striæ shallower and more finely crenulate, interstices not convex, distinctly setulose-punctate, inner humeral angle less marked; abdomen setulose-punctate, etc.

*SAROTHROCREPIS BLACKBURNI*, n. sp.

Depressed; prothorax subquadrate, widest before middle, basal angles marked but obtuse; elytra subquadrangular, finely crenu-



late-striate, interstices lightly convex. Testaceous, femora much paler than tibiae; elytra with piceous pattern forming a transverse ante-apical band, from which a narrow sutural stripe (on first interstice of each elytron) extends forward to scutellum, and a wide lateral stripe on interstices 6-9 extends forward to humeral angle.

Head ordinary (1.2 mm. across eyes). Prothorax broader than long (1.2 × 1.75 mm.), wider at base (1.5 mm.) than apex (1.2 mm.); sides arcuate at widest part, roundly and decidedly narrowed to apex, obliquely narrowed to base, subsinuate just before basal angles; disc convex; lateral margins narrow anteriorly, wide but not explanate posteriorly, apex truncate; anterior angles obtuse, not marked, bordered; base rounded. Elytra much broader than prothorax (3.8 × 2.8 mm.), broadest behind middle; base truncate; humeral angles widely rounded; apex truncate (hardly oblique on each side); interstices shagreened, third, fifth, and seventh with a few fine punctures on the dark ante-apical part. Apex of abdomen in ♂ widely and deeply triangularly excised. All the tarsi with fourth joint bilobed, intermediate tarsi in ♂ squamulose beneath. Length 5.6-6, breadth 2.2-3 mm.

*Hab.*—Dorrigo (common under loose bark on trunks of Eucalypts).

I believe that, on account of the shape of the palpi and prothorax, the Rev. Thos. Blackburn would place this species in his genus *Ectroma*.<sup>\*</sup> It is much larger than any species which Mr. Blackburn has referred to that genus, but is evidently allied to *Lebiomorpha benefica* Newm. No other species of *Sarothrocrepis* that I have examined, has the apex of the abdomen in the ♂ so widely and deeply excised.

*AGONOCHILA QUADRICOLLIS*, n.sp.

Depressed, elongate; head small; prothorax small, narrow, basal angles obtuse though marked; elytra much broader than prothorax

<sup>\*</sup>*Lebia civilis* Newm., is the typical species of the Rev. Thos. Blackburn's genus *Ectroma* (cf. These Proceedings iv.(2), 1899, p.719). The name *Ectroma* had already been used when Mr. Blackburn proposed it, but Baron de Chaudoir had proposed the name *Lebiomorpha* for the same group (cf. Bull. Soc. Imp. Nat. Mosc. 1876, p.80).

(2.8 × 2.1 mm.), finely and rather closely setulose-punctate. Piceous; head reddish near base; prothorax piceous-brown, reddish near margins; elytra piceous, reflexed margins, apex and a large irregular discal plaga on each elytron testaceous; under-surface reddish-brown, becoming piceous on sides of abdomen; legs, antennæ, labrum and palpi testaceous.

Head (1 mm. across eyes) very finely shagreened, and with scattered, minute, setulose punctures. Prothorax broader than long (0.85 × 1.3 mm.), broadest about anterior third; derm very minutely shagreened, and beset with small setulose punctures; disc a little convex; lateral margins wide, depressed, widest towards base, slightly angulate and setigerous at widest part; sides obliquely narrowed to apex, lightly narrowed to base, hardly subsinuate before base; base lightly lobate in middle, obliquely truncate on each side; basal angles obtuse; median line strongly impressed. Length 5, breadth 2.1 mm.

*Hab.*—N. S. Wales: Sydney (Lea), National Park (Taylor), Dorrigo (Cox).

This species is allied to *A. biguttata* Chaud., from which it differs by prothorax, with sides, not so angulate at widest part, nor decidedly sinuate posteriorly; elytra with discal plaga not so narrow, but with an expansion outside in middle of external side (as in *A. curtula* Erichs.). My description is founded on two specimens given to me by Mr. F. H. Taylor, ticketed "National Park."

*AGONOCHILA PUNCTULATA*, n.sp.

Depressed; head, prothorax, and elytra setigero-punctate; prothorax transverse, lightly emarginate at apex, basal angles rectangular, two marginal setæ on each side; elytra broad, densely and rather coarsely setulose-punctate (setæ yellow), striæ and interstices indefinite. Head, disc of prothorax, peduncle, a sutural stripe and a lateral space on elytra piceous; a wide indeterminate area on each elytron extending from shoulders nearly to apex and uniting at basal third testaceous; sides of prothorax more lightly coloured than disc; legs and antennæ testaceous.

Head wide(1.1 mm. across eyes); front and clypeus depressed, punctate, the punctures stronger on front; eyes prominent. Prothorax transverse( $0.8 \times 1.6$  mm.), broadest a little before middle, a little more narrowed to apex(1.15 mm.) than to base(1.3 mm.); disc convex; lateral margins wide; puncturation close towards margins, sparse in centre of disc; sides subangulate and bearing anterior marginal seta at widest part, lightly narrowed posteriorly, subsinuate just before basal angles; anterior angles obtuse but marked, hardly advanced; base widely and shortly lobed in middle, truncate (but a little oblique) on each side; basal angles rectangular; median line strongly impressed. Elytra much broader than prothorax( $3 \times 2.4$  mm.), depressed, broadest behind middle, a little narrowed to base, rounded at humeral angles, roundly truncate at apex. Length 4.9-5.2, breadth 2.4 mm.

*Hab.*—Dorrigo(on the trunk of a Eucalypt), Glen Innes(Carter).

I cannot identify this species as one of those described by Chaudoir. From *A. cribripennis* Chaud., it differs conspicuously by the prothorax with only one anterior marginal seta (not three or four), anterior angles less prominent, basal angles less acute. From *A. macleayi* Sl., it differs by smaller size, stronger puncturation of head, prothorax, and elytra; darker colour; angles of prothorax more marked, etc.

It requires comparison with *A. suturalis* MacI., unknown to me in nature, which should have the prothorax yellow; unfortunately the description of *A. suturalis* gives no information as to the shape of the prothorax.

#### *AGONOCHILA MACLEAYI*, n.sp.

Depressed; head, prothorax, and elytra beset with fine short hairs, under a lens; prothorax subquadrate, apex lightly emarginate, basal angles well marked but obtuse, two marginal setae on each side; elytra broad, densely and finely punctulate; striae and interstices indefinite, third interstice 3-setose (anterior seta at basal fifth, second a little behind middle, third a little behind apex of sutural vitta). Yellow-testaceous; elytra more lightly coloured than prothorax and head, 3-vittate, a sutural vitta

extending backwards from scutellum to apical fifth, a little wider and extending on to third interstice near apex; also a lateral vitta on each elytron, this lateral vitta narrow, but a little variable in width and length.

Head broad (1.4 mm. across eyes), depressed, minutely shagreened and punctate under a lens; eyes large, prominent. Prothorax transverse (1.15 x 2 mm.), widest a little before middle, hardly narrower at apex (1.6 mm.) than at base (1.7 mm.), shagreened, minutely punctulate; lateral margins explanate, not coarsely punctate; sides roundly subangulate and setigerous at widest part, lightly narrowed (hardly subsinuate) posteriorly; apex lightly and widely emarginate; anterior angles wide, obtuse; base shortly lobed in middle, oblique on each side; basal angles marked, obtuse at summit; median line strongly impressed. Elytra subquadrate (4.1 x 3.2 mm.), broadest behind middle, rounded on sides; humeral angle rounded, inner humeral angle widely rounded. Length 6.3-6.8, breadth 3.3-2 mm.

*Hab.*—Dorrigo (plentiful under bark, on the trunks of Eucalypts).

This species resembles *A. cribripennis* Chaud., but is larger, and differs conspicuously by the prothorax with only two setae on each side, not strongly sinuate on sides posteriorly, basal angles not acutely rectangular, lateral margins not coarsely punctate; elytra far more finely punctulate, etc.

*PHILOPLÆUS LUCULENTUS* Newman, var. *GUTTIFERA*, var. nov.

Compared with specimens from Monbulk, Victoria (about 30 miles east from Melbourne), which evidently represent the typical form of *Ph. luculentus* Newm., var. *guttifera* agrees in facies (the prothorax has the lateral margins a little narrower before the anterior marginal puncture, and the anterior angles a little more marked); but differs by prothorax slightly infuscate on disc, elytra with a finer puncturation; also, by pattern of elytra. *Ph. luculentus* has the elytra piceous-black, with a large antemedian space on each elytron, and the apex testaceous; the antemedian space broader than long, extending across interstices 2-7, much

longer on interstices 2-4; the apical testaceous area narrow, irregular on its anterior margin, decidedly divided from the antemedian spaces by a broad black band. In var. *guttifera* the elytra are testaceous, with the base and sides widely margined with black, suture black on anterior three-fourths, the sutural black part very narrow (occupying only the first interstice of each elytron) behind black basal area, expanding at median puncture of third interstice to cover the four inner interstices of each elytron, this postmedian black area irregular in outline, narrower externally than internally; two small elongate black spots on fifth interstice, anterior spot a little forward from the level of the median puncture of the third interstice, posterior spot extending forward from level with the third puncture of the third interstice; sixth interstice with a small oblong black spot opposite median puncture of third interstice. Length 7, breadth 3.15mm.

The posterior expansion of the sutural black area is truncate-sagittate on the three inner interstices of each elytron, and the small part on the fourth interstice may be looked upon as merely a lateral attachment; this spot of the fourth interstice, with those of the fifth and sixth interstices, may be considered to be the remnants of the postmedian black band of the typical form of *Ph. luculentus*. A specimen taken by me at Orange, N.S.W., is intermediate between the typical form of *Ph. luculentus* and var. *guttifera*, and indicates that differences in the elytral pattern are merely of minor importance.

*Hab.*—Dorrigo.

*TRECHUS COXI*, n.sp.

Black; prothorax with lateral border reddish; elytra with a posthumeral transverse macula extending across interstices 5-9 and a narrow broken transverse postmedian fascia yellow; under-surface reddish; legs testaceous, tibiae and tarsi darker than femora; antennae infusate, basal joint testaceous.

Oval; prothorax broader than long, broadest before middle, wider across base than apex, strongly narrowed to apex, very lightly narrowed to base; sides widely margined; margins widest at base; basal angles rectangular. Elytra widely oval, very

convex, much broader than prothorax, faintly striate; first stria entire, passing round apex of each elytron and curving forward on apical declivity at about the position of the sixth interstice; other striae only faintly traceable; fourth interstice with a puncture a little behind the humeral point of origin of the lateral border; third interstice 2-punctate, the anterior puncture a little behind middle, posterior puncture near apex. Length 4.4-25, breadth 1.85-2 mm.

*Hab.*—Dorrigo (H. W. Cox).

Six specimens of this pretty little species were sent to me by Mr. H. W. Cox, ticketed "Dorrigo." It is very distinct from all the described Australian species. Following the Rev. Thos. Blackburn's Table of the Australian species of *Trechus* (Trans. Roy Soc. S. Aust., 1901, p.127), the elytra not fully striate would place it beside *T. baldiensis* Blkb., and *T. solidior* Blkb., both obscurely coloured species without an elytral pattern.

#### APPENDIX: TENEBRIONIDÆ FROM DORRIGO.

BY H. J. CARTER, B.A., F.E.S.

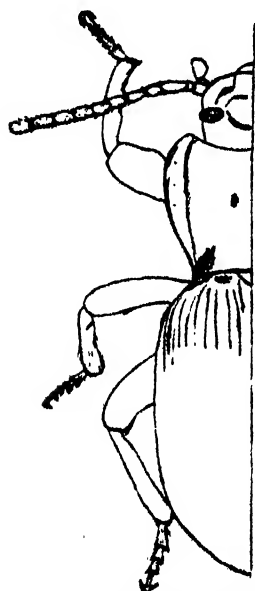
List of *Tenebrionidæ* taken at Dorrigo and Bellingen (July, 1910): *Platydesma striata* Montr., *Ceropria peregrina* Pasc., *C. valga* Pasc., *Aethosus brunneus* Cart., *A. laticornis* Pasc., *Toxicum* spp.(2), *Pterohelaeus planus*(?) Bless., *P. usellus* Pasc., *Hypaulax ovalis* Bates, *Nyctobates crenata* Boisd., *Encyalesthus punctipennis* Pasc., *Promethis Pascoei* Macl., *Menephus cærulescens* Haag-Rut., *M. parvulus* Macl., *M. sydneyensis* Blkb., *Menestis laticeollis* Boisd., *M. servulus* Pasc., *Titena columbina* Erichs., *Cardiothorax egerius* Pasc., (Bellingen), *C. cordicollis* Pasc., (Coff's Harbour) *C. femoratus* Bates, var., (Coff's Harbour), *C. dorrigoensis*, n.sp., *C. iridipes*, n.sp., *Blaspegenes equestris* Pasc., *Otrintus Jacksoni* Cart., *Adelium geminatum* Pasc., *A. Helmsi* Cart., *A. porcatum* Fabr., var., (Bellingen), *A. reductum* Pasc., *Apasie sinuaticollis*, n.sp., *Amarygmus striatus* Macl., *A. tristis* Fabr.,

*Chalcopterus punctulatus* Blkb., (Coff's Harbour), *Chalcopterus* spp. (2?). Total: 35 species, including three new species.

CARDIOTHORAX DORRIGOENSIS, n.sp. (Fig. 1.)

♂. Elongate-ovate, violet-bronze, nitid, antennæ fuscous-brown, tarsi piceous clothed beneath with reddish hair, undersurface nitid black.

Head impunctate, labrum emarginate and fringed with red hair, the usual frontal impression distinct, with two deep foveæ near front angles of epistoma; canthus raised and somewhat triangulate; antennæ longer than prothorax, third joint equal to that of the first two combined, eleventh



elongate. Prothorax 4 x 5 mm., finely margined throughout, wider at apex than at base, widest in front of middle, arcuate-emarginate at apex and base, front angles subacute but rounded, sides slightly rounded with curve strongest anteriorly, sinuate near base, hind angles acute, dentate and twisted downwards and horizontally outwards; foliate margins wide, flat, and brightly metallic, slightly narrowed at base, with a shallow separating sulcus on anterior portion, with six setiferous punctures placed at equal distances near the border, disc smooth, central channel well marked throughout, two large basal foveæ accentuating the angular torsion. Scutellum triangular, without any adjacent depression. Elytra wider at base than

prothorax, moderately convex, shoulders advanced but rounded, epipleural fold forming a raised margin, on each elytron eight well marked sulci, intervals convex, the fifth wider than the rest, a row of very small punctures on the sides, epipleuræ and abdomen smooth; all femora emarginate

Fig. 1.—*C. dorrigoensis*.

within at the apex, intermediate and posterior femora dentate near apex, that on the posterior much the larger and lobate, anterior tibiæ slightly bowed, intermediate and posterior tibiæ nearly straight.

♀. Differs from the male in having thinner and undentate femora, the antennæ shorter, and the posterior tibiæ quite straight.  
*Dimensions*—♂.  $17 \times 6$  mm.; ♀.  $18 \times 6.3$  mm.

*Hab.*—Dorrigo, New South Wales.

Two specimens; the sexes were taken, by the author, in July of the present year. This species differs from, though most closely allied to, *C. femoratus* Bates, in the following characters: Size larger, colours more brilliant, especially on pronotum and the foliate margins thereof, and particular in the *strongly dentate hind angles of prothorax and the antecedent sinuation of the sides*. The tooth on the posterior femora, though large and lobate, is not so prolonged in my specimen as in specimens of *C. femoratus* Bates, from the Tweed and Yarrow Creek districts.

#### CARDIOTHORAX IRIDIPES, n.sp. (Fig. 2.)

Elongate-ovate, dark purple-bronze, nitid, pronotum with violet reflections, underside nitid black, femora and tibiæ iridescent purple and cyaneous, antennæ and tarsi piceous.

*Head* with labrum prominent, narrow and truncate, epistoma convex, wide, a little raised at sides, minutely and closely punctate, forehead with impression squarely truncate and deeply indented in front, rounded behind, with about six large punctures thereon; antennæ  $4\frac{1}{2}$  mm. long, joints 3-7 elongate-obconic, third longer than fourth, 8-11 successively but only slightly wider and shorter, eleventh ovoid-acuminate. *Prothorax*  $3 \times 3\frac{1}{4}$  mm., wider at apex than at base, greatest width in front of middle, apex slightly concave with obtusely rounded anterior angles scarcely prominent, sides slightly rounded in an even curve till near base, then rather abruptly sinuate and deflexed at the posterior angles, these forming a subrectangular tooth a little twisted downwards and outwards; base truncate; foliaceous margins narrow, sub-horizontal, widest at middle, the separating discal line nearly



straight and forming a deep sulcus at middle; four setiferous punctures on margins near border; extreme border smooth, raised throughout, widest at sides; disc very minutely and closely punctate (only seen under a strong lens), medial line strongly impressed throughout, on each side of this a faint irregular longitudinal impression. *Scutellum* triangular. *Elytra* a regular oval, wider than prothorax at base, and about  $2\frac{1}{2}$  times as long, shoulders moderately rounded, epipleural fold scarcely evident, with nine sulci on each elytron, intervals subequal, convex, more sharply defined at apex; epipleuræ and abdomen irregularly impressed and very minutely punctured, sternum smooth, fore tibiæ slender, minutely spined at apex, posterior tibiæ curved, with apex bent forward. *Dimensions*— $11 \times 4$  mm.

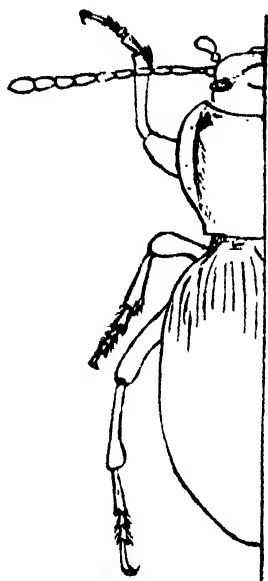


Fig. 2.—*C. iridipes*.

*Hab.*—Coff's Harbour, New South Wales.

A single specimen, probably male, from its bent hind tibiæ, taken by Mr. H. W. Cox, and generously given me. It presents at least one character peculiar to the genus in its brightly iridescent and coloured femora. It is most closely allied in size and form to *C. pygmaeus* Cart., but differs from that species in (1) narrower and more elongate prothorax, with narrower foliation; (2) posterior angles of prothorax rectangular, anterior angles obtuse; in *C. pygmaeus* both angles are acute; (3) darker and more violet-bronze colour; and (4) elytral intervals less sharply defined. Type in author's Collection.

**APASIS SINUATICOLLIS, n.sp. (Fig. 3.)**

♂. Elongate-ovate, violet-bronze, very nitid, apical joints of antennæ obfuscated, tarsi reddish, underside metallic-black.

*Head* widely truncate in front of epistoma, with a setiferous puncture inside each angle of the raised border, labrum emarginate, canthus raised and somewhat



nodiform, frontal depression in form of a horseshoe, sparsely punctured, with two foveæ near epistoma, submentum coarsely punctured on lateral borders, sharply bidentate near middle, antennæ considerably longer than prothorax, (when at rest with three apical joints projecting beyond its base) third joint about as long as fourth and fifth combined, joints 8-10 slightly enlarged, eleventh elongate, acuminate. *Prothorax* 3.5 x 4 mm., moderately convex, apex truncate, base slightly arcuate (posterior outline convex), apex and base of equal width, sides widest at middle, slightly rounded on anterior half, sinuate on basal half, all angles obtuse and rounded, with narrow raised border throughout, margins not foliaceous

Fig. 3.—*A. sinuaticollis*.

but defined by a shallow sulcus, bearing a setiferous puncture near anterior angle; disc smooth, impunctate, without central canal (or indicated only by a fovea near front margin), surface a little uneven near basal margin. *Scutellum* small, rounded, with a narrow triangular sulcus on the adjacent suture. *Elytra* three times as long as prothorax, and wider than it, acuminate-elliptic, humeri obsolete, epipleural fold not visible from above, greatest width at middle, with eight sulci on each elytron, and two on sides, intervals equal, impunctate, flat near the centre of disc, convex towards sides and apex, epipleuræ narrow and smooth; abdomen quite smooth except for a few minute setæ bearing fine yellow hairs, and impressions on each segment laterally; all femora emarginate on outside border and

smooth, all tibiæ straight and slightly tomentose at apex, two basal joints of anterior tarsi enlarged; intercoxal process truncate.

♀. More robust, elytra wider and more convex, anterior tarsi not enlarged, antennæ shorter.

*Dimensions*.—♂, 1.6 × 5 mm.; ♀, 1.6 × 5.6 mm.

*Hab.*.—Dorrigo, New South Wales.

Six specimens, taken by the author, July, 1910; under bark of rotting timber; also taken by Mr. Cox in the same district.

Its nearest ally is *A. beplegenoides* Cart., from which it differs in (1) smaller size, (2) lighter colour, (3) in the sinuate prothorax, and the absence of central impression thereon, *inter alia*.

Types in author's Collection.

*Cardiothorax femoratus* Bates, var. *subdentatus* Cart.—Mr. H. W. Cox took a large number of specimens near Coff's Harbour, which differ from the typical form in having a small but distinct dentation of the hind angles of prothorax. There is, however, one specimen, at least, amongst them, in which this small outwardly directed tooth is absent; and I have, in my collection, a specimen from Bellinger River, taken by Mr. Jackson, also of the typical form (i.e., without any appearance of a tooth), so that it would appear that this character is variable in this district. The species is so strikingly different, in its femoral characters, from all other species; and the tooth is so small, that it does not seem to me desirable to describe it as a distinct species. The absence or presence of this tooth is certainly not a sexual character, since both sexes of the typical form, and of the variety, are before me.

*Adelium porcatum* Fabr., var. *fulgens* Cart.—Specimens taken under bark of Eucalypts, near Bellinger, present a striking colour-variation from the normal type. This colour is a brilliant violet-bronze, but darker specimens occurred amongst them. The structural characters are normal.

## NOTE ON THE OCCURRENCE OF A LIMESTONE- FLORA AT GROSE VALE.

BY W. M. CARNE.

Instances of the part played by geological formation in the distribution of species and the formation of plant-communities in New South Wales, have been put forward from time to time, by various botanical and other workers. So far as the writer is aware, no record has yet been published dealing with the effect of a lime-deposit on vegetation.

The present note deals with an interesting, though small, patch of vegetation occurring on an outcrop of a limestone at Grose Vale, Hawkesbury District. The deposit is to be found below Box Hill, and is followed by the Horseshoe Bend Road, which, running N.E. and S.W., joins the main Kurrajong and Grose Vale Roads. It is on the eastern slope of the hill, which curves to form a natural amphitheatre sheltering orchards and other cultivated areas. At about 100 yards from the Grose Vale end, and following the road for about half a mile, nearly to what is known as Lookout Hill, is the outcrop, with its vegetation, which is so distinct as to be noticeable against the hillside from several miles away. Another small deposit, denuded of timber, occurs near the church, about half a mile from Kurrajong Road. The deposit is about 800 feet above sea-level, and about 8 miles by road from Richmond.

The dense growth of trees, entangled with many creepers, and the absence of Eucalypts, resembles that of the luxuriant gully-brushes of the eastern slopes of Kurrajong Range; or, perhaps, more nearly, those on volcanic soils, such as at Mountain Lagoon, Mount Wilson, or even of the Illawarra slopes. Above the road, this vegetation extends nowhere more than 20 yards, while, on the steep slope below, its width has been much greater, probably owing to the soil having been washed down from the outcrop

above. Much of the lower portion has, however, been cleared, and only a few patches remain to indicate the once luxuriant nature of the flora.

The soil, in colour, is a brownish-white, and of a loose granular texture. Where the rock is exposed, it is not unlike basalt, and as such it is locally taken to be, a mistake probably influenced, to some extent, by the vegetation. Where it is weathered, it resembles a very soft sandstone. Mr. H. G. Smith\* has recorded deposits of similar limestone from Auburn and from Homebush. Like that at Grose Vale, they occur as deposits in the Wianamatta Shales. Mr. Smith informs me that the Grose Vale rock contains more sand than the two deposits mentioned, but is almost identical with that found near Lakemba, on the railway between Belmore and Bankstown. Not being naturally exposed, no botanical indications of these deposits were noted by him. Referring to the Auburn deposit, he says: "When first broken, it is of a blue-grey colour, not much unlike basalt; it was spoken of as 'blue metal' by the quarrymen, who no doubt consider it identical with the igneous rock bearing the same name. On weathering, the limestone becomes lighter grey in colour." In all these deposits no sign of organic structure can be detected under the microscope. Mr. Smith classes them as hydraulic limestones. The normal soil of the Vale is that of the Wianamatta Shales, with the usual flora of stringybarks, ironbarks, red gum, blackthorn, etc.

The explanation of this very distinct and localised plant-community seems to be due to (1) the richness of the soil due to the relatively large amount of lime present, with its accompanying greater availability of plant-foods, and its improved physical nature; (2) the sheltered eastern aspect; and (3) the good rainfall.

The following is Mr. Smith's analysis of the Auburn rock:—

CaCO <sub>3</sub>	...	...	= 89·678%	MnCO <sub>3</sub>	...	...	...	= 0·425%
Clay	...	...	= 39·416%	MgCO <sub>3</sub>	...	...	...	= 1·625%
Fe <sub>2</sub> O <sub>3</sub>	...	...	= 2·686%	Alkalies present as chlorides	...	...	...	= 0·678%
FeCO <sub>3</sub>	...	...	= 13·480%	Water	...	...	...	= 2·111%

\* Smith, H. G., "Preliminary Note on Limestone occurring near Sydney." Journ. Proc. Roy. Soc. New South Wales, xxvi., 1892, p. 302.

An average sample of the soil at Grose Vale has been found, by Mr. M. S. Benjamin, Assistant Chemist, Hawkesbury Agricultural College, to contain 4.23% of lime. The litmus reaction is faintly alkaline. Round the outcrop, owing to the intermingling of the shale with the limestone, and the leaching of the latter, the amount of lime is much smaller, less than 0.5%. Here the two floras tend to mingle to some extent, although the boundaries of the two are remarkably distinct. Here, too, are found some plants, marked (†) in the accompanying list, which, while not occurring on the limestone proper, are hardly typical of the Wianamatta proper. These may be almost classed as an intermediate flora. It may be mentioned that Wianamatta soils give a strongly acid litmus reaction, and an average analysis of ten samples shows only 0.136% of lime.\* Where, as in Australia, soils tend to be deficient in lime, the amount present is often, to a large extent, indicative of the value of the soil to plants.† It is recognised in agriculture that the value of lime in a soil lies, not so much in itself directly, as in the part it plays in encouraging bacterial action, in rendering soil-foods available to plants, and in improving the texture of the soil. The chief cause of the luxuriant brush-like vegetation under consideration is the rich open soil, resulting from the presence of an unusual amount of lime. The difference in the vegetation on acid and basic granites, as pointed out by Mr. Cambage and others, is due to the same reason, for "acid granites low in lime-minerals yield poor soils; basic granites fairly well supplied with lime-minerals yield good soils."‡ "Although the characteristics of the lime-flora are clear and distinct, yet, in the past, the influence of lime upon vegetation has been overestimated. Indeed, a distinction has been made between calciphilous and calciphobous plants. Recently it has been definitely established that the amount of lime, in

\* Jensen, H. I., *Agric. Gazette of New South Wales*, 1910, p.463.

† Guthrie, F. B., *Agric. Gazette of New South Wales*, 1898, p.494; and Jensen, H. I., *op. cit.* 1909, p.1001.

‡ Jensen, H. I., *Agric. Gazette of New South Wales*, 1910, p.105.

itself, in so far as it does not operate physically, cannot be the cause of differences in the flora, for not only can calcicolous plants be cultivated in soil that is poor in lime, but silicicolous plants, and even bog mosses, which are regarded as pre-eminently calciphobous, can grow vigorously in pure lime-water, if the aqueous solution be otherwise poor in dissolved salts. It has been overlooked that nearly all lime-soils are rich in soluble mineral substances, and this wealth excludes plants belonging to poorer soils; beyond this, the important physical characters of calcareous soils come into play.”||

As to where the plants forming this flora came from, it seems sufficient to regard them, like the plants of the Blue Mountain gullies, as remnants of the old tropical flora, which at one time extended as far south as Victoria. Superior conditions in circumscribed localities have enabled these remnants to persist, while the rest of the country has become occupied by the present, dominant, hardy flora which the drier conditions of to-day have evolved.

The rainfall is good, about 33 inches.¶ Kurrajong Heights, three miles away, and 1,000 feet higher, averages 50 inches per annum. The moisture-capacity of the soil is equal to that of the shale, but its capillarity is much greater. The loss of water by evaporation must, however, have been largely checked, before any clearing had been carried out, by the dense shading of the soil. The area certainly gains moisture by soakage from the steep slopes above. The road remains moist after rain, long

|| Warming, E., “Ecology of Plants.” 1909, p.58.

¶ Of late years there has been a general diminution of rainfall in this district (see Bulletin No.2, Commonwealth Bureau of Meteorology, 1908).

For the following figures I am indebted to Mr. W. S. Arnold, who lives not far from the limestone-outcrop.

	1903.	1904.	1905.	1906.	1907.	1908.	1909.	
Compare	42·24	37·96	26·18	25·17	21·35	29·48	25·98	Average, 29 years = 29·90
Richmond	33·32	33·95	22·64	17·17	17·77	25·06	23·07	

after the soil-surface of the shale round about has dried up. On drying, instead of caking, the soil becomes loose and open. Moisture is thus readily absorbed, instead of running off down the steep slopes. Severe frosts are unknown.

As the outcrop occurs inside the amphitheatre, and some way down the hill-side, the aspect, facing the morning sun, and sheltered from the westerly winds, is almost an ideal one. These matters of aspect and rainfall are almost sufficient, in themselves, to bring into existence the well-known vegetation of *Sassafras*, *Coachwood*, *Myrtles*, *Tree-ferns*, etc., typical of the gullies of the eastern slopes of the Kurrajong, had there been sheltered gullies. But the position is too exposed, and the vegetation quite distinct. It is not confined to such small gullies as there are, but climbs up their sides and spreads along the hill-slopes.

In the following list, those plants marked \* are believed to owe their position to the favourable conditions offered by the limestone-soil. Many of these plants are admittedly found on sandstone country, but they are not typical of that soil; and the explanation of their presence is probably to be found in the favourable local conditions. Mr. Hamilton§ shows, that at Mt. Wilson, most of these plants prefer the basalt to the sandstone.

I have to thank Messrs. J. H. Maiden and C. T. Musson for assistance in the preparation of this note.

RANUNCULACEÆ	... <i>Clematis aristata</i> R.Br. <i>glycinoides</i> DC.
MAGNOLIACEÆ	...* <i>Drimys dipetala</i> F.v.M.
ANONACEÆ	... * <i>Eupomatia laurina</i> R.Br.
MENISPERMACEÆ	...* <i>Cocculus Moorei</i> F.v.M. * <i>Sarcopetalum Harveyanum</i> F.v.M.
CRUCIFERÆ	... <i>Lepidium ruderales</i> L.
PITTOSPORACEÆ	...* <i>Hymenosporum flavum</i> F.v.M. <i>Bursaria spinosa</i> Cav. * <i>Citriobatus multiflorus</i> A. Cunn.

§ Proc. Linn. Soc. N. S. Wales, 1899, p.346.

\*Found on the limestone. †Introduced weeds. ‡Intermediate flora (p.851.)



MALVACEÆ ...	... <i>Sida rhombifolia</i> L. <i>Abutilon oxycarpum</i> F.v.M. * <i>Hibiscus heterophyllus</i> Vent. † <i>Modiola multifida</i> Moench.
STERCULIACEÆ	...† <i>Sterculia diversifolia</i> G. Don.
LINEÆ	...† <i>Linum gallicum</i> L.
GERANIACEÆ	... <i>Geranium pilosum</i> Sol.
RUTACEÆ ...	...† <i>Evodia micrococca</i> F.v.M. * <i>Acrornychia Baueri</i> Schott.
MELIACEÆ ...	...* <i>Melia composita</i> Willd. * <i>Cedrela toona</i> Roxb.
CELASTRINEÆ	...* <i>Elacodendron australe</i> F.v.M.
RHAMNEÆ ...	...* <i>Alphitonia excelsa</i> Reiss.
AMPELIDEÆ..	...* <i>Vitis antarctica</i> Benth. * <i>clematidea</i> F.v.M. * <i>hypoglauca</i> F.v.M.
SAPINDACEÆ	...* <i>Cupania semiglauca</i> F.v.M. * <i>Nephelium leiocarpum</i> F.v.M. <i>Dodonaea viscosa</i> L.
LEGUMINOSÆ	... <i>Indigofera australis</i> Willd. <i>Desmodium brachypodium</i> A. Gray. <i>Glycine clandestina</i> Wendl. † <i>Medicago minima</i> Willd. † <i>denticulata</i> Willd. † <i>Vicia hirsuta</i> Koch. * <i>Cassia laevigata</i> Willd. * <i>australis</i> Sims. <i>Acacia longifolia</i> Willd. <i>decurrens</i> Willd. † <i>Trifolium repens</i> L. † <i>dubium</i> Sibth.
ROSACEÆ ...	... <i>Rubus parvifolius</i> L. * <i>moluccanus</i> L. <i>Acaena ovina</i> Cunn. <i>sanguisorbas</i> Vahl. † <i>Rosa rubiginosa</i> L.

- SAXIFRAGÆ ... † *Aphanopetalum resinosum* Endl.  
 \* *Cutleria viburnea* F.v.M.
- MYRTACEÆ ... .. *Callistemon salignus* DC.  
*Melaleuca styphelioides* Sm.  
*Eucalyptus hemiphloia* F.v.M.  
*tereticornis* Sm.  
 \* *Rhodamnia trinervia* Bl.  
 \* *Eugenia Smithii* Poir.
- ONAGRARIÆ ... *Epilobium glabellum* Forst.  
 † *Oenothera rosea* Willd.  
 † *tetraptera* Cav.
- PASSIFLOREÆ ... \* *Passiflora aurantia* Forst.
- UMBELLIFERÆ ... *Apium leptophyllum* F.v.M.  
*Daucus brachiatus* Sieb.
- CAPRIFOLIACEÆ ... \* *Sambucus xanthocarpa* F.v.M.
- COMPOSITÆ ... *Vittadinia australis* A. Rich,  
 var. *tenuissima*,  
*Calotis lappulacea* Benth.  
 † *Xanthium spinosum* L.  
*Siegesbeckia orientalis* L.  
*Bidens pilosus* L.  
 † *Tagetes glandulifera* Schrank.  
*Helichrysum diosmifolium* Don.  
*Erechtites arguta* DC.  
 † *Carduus lanceolata* L.  
 † *Sonchus oleraceus* L.
- CAMPANULACEÆ ... *Wahlenbergia gracilis* DC.  
*Lobelia purpurascens* R.Br.
- EPACRIDÆÆ ... *Leucopogon juniperinus* R.Br.
- PRIMULACEÆ ... † *Anagallis arvensis* L. (red and blue varieties)
- MYRSINÆÆ ... † *Rapanea (Myrsine) variabilis* Mez.
- EBENACEÆ ... \* *Cargillia australis* R.Br.
- JASMINEÆ ... *Notelasa longifolia* Vent.
- ASCLEPIADEÆ ... \* *Marsdenia rostrata* R.Br.  
 † *Gomphocarpus fruticosus* R.Br.
- GENTIANÆ ... *Erythraea australis* R.Br.

ASPERIFOLIÆ	...*	<i>Ehretia acuminata</i> R.Br.
CONVOLVULACÆ	...	<i>Dichondra repens</i> Forst.
SOLANÆ	...	<i>Solanum nigrum</i> L.
	†	<i>pseudo-capsicum</i> L.
		<i>stelligerum</i> Sm.
		<i>xanthocarpum</i> Schrad.
	†	<i>Physalis peruviana</i> L.
		<i>Nicotiana suaveolens</i> Lehm.
BIGNONIACÆ	...†	<i>Tecoma australis</i> R.Br.
ACANTHACÆ	...	<i>Eranthemum variabile</i> R.Br.
MYOPORINÆ	...	<i>Myoporum debile</i> R.Br.
VERBENACÆ	..	† <i>Verbena bonariensis</i> L.
	†	<i>venosa</i> G. & H.
	†	<i>Clerodendron tomentosum</i> R.Br.
LABIATÆ	...	<i>Plectranthus parviflorus</i> Willd.
		<i>Mentha gracilis</i> R.Br.
PLANTAGINÆ	...	<i>Plantago varia</i> R.Br.
	†	<i>lanceolata</i> L.
PHYTOLACCACÆ	...†	<i>Phytolacca octandra</i> L.
CHENOPODIACÆ	...	<i>Chenopodium triangulare</i> R.Br.
	†	<i>ambrosioides</i> L.
AMARANTACÆ	...	<i>Nyssanthus erecta</i> R.Br.
POLYGONACÆ	...	<i>Rumex Brownii</i> Campd.
	†	<i>Polygonum convolvulus</i> L.
LAURINÆ	...*	<i>Endiandra</i> (?).
		<i>Litsea dealbata</i> Nees.
EUPHORBIACÆ	..	† <i>Phyllanthus Ferdinandi</i> J. Muell.
	†	<i>Gastroemii</i> J. Muell.
	†	<i>Breynia oblongifolia</i> J. Muell.
	†	<i>Croton Verreauxii</i> Baill.
		<i>Carumbium populifolium</i> Reinw.
URTICACÆ	...	<i>Urtica incisa</i> Poir.
	†	<i>Trema aspera</i> Bl.
		<i>Ficus stephanocarpa</i> Warb.
		<i>Cudrania javanensis</i> Trecul.

- SANTALACEÆ .. \**Santalum obtusifolium* R.Br.  
*Exocarpus cupressiformis* Labill.
- IRIDEE .. \**Sisyrinchium paniculatum* Spreng.
- LILIACEÆ .. *Smilax australis* R.Br.  
*Dianella longifolia* R.Br.  
*Eustrephus latifolius* R.Br.  
*Geitonoplesium cymosum* A. Cunn.  
*Xerotes longifolia* R.Br.
- COMMELYNACEÆ .. *Commelina cyanea* R.Br.
- JUNCACEÆ ... .. *Juncus polyanthemus* F. Buch.
- CYPERACEÆ .. *Gahnia melanocarpa* R.Br.  
*aspera* Spreng.  
*Carex longifolia* R.Br.  
*appressa* R.Br.
- GRAMINEÆ ... .. *Panicum pygmaeum* R.Br.  
*Oplismenus setarius* Roem. & Schult.  
\**Cenchrus australis* R.Br.  
*Andropogon sericeus* R.Br.  
*portusus* Willd.  
*refractus* R.Br.  
*Microlaena stipoides* R.Br.  
*Aristida vagans* Cav.  
*Stipa verticillata* Nees.  
*pubescens* R.Br.  
*Dichelachne sciurea* Hook.  
*Danthonia pilosa* R.Br.  
*Echinopogon ovatus* Palis.  
*Cynodon dactylon* L. C. Rich.  
*Leptochloa decipiens* Stapf.  
*Sporobolus indicus* R.Br.  
*Lindleyi* Benth.  
*Eragrostis leptostachya* Steud.  
† *Briza maxima* L.  
† *minor* L.  
† *Festuca bromoides* L.  
† *Hordeum murinum* Caesalp.

FILICES	...	...* <i>Adiantum formosum</i> R.Br.
•		* <i>Adiantum affine</i> Willd.
		* <i>Pellaea falcata</i> Fic.
		* <i>Doodia aspera</i> R.Br.

Total 57 families, 130 genera, and 156 species. It is remarkable how few genera are represented by more than one species.

There is no doubt that, even up to recent years, this flora covered an area much larger than it does to-day. Many roadside plants, both native and introduced, have established themselves. Clearing is still going on. The conditions for luxuriant growth are no longer so favourable, and in a few years this interesting patch of vegetation will probably disappear.

ON SOME REMARKABLE AUSTRALIAN  
*LIBELLULINÆ*.

By R. J. TILLYARD, M.A., F.E.S.

PART III. FURTHER NOTES ON *CAMACINIA OTHELLO* Tillyard.

(Plate xvii., fig.3.)

Since I first published the description of a unique male of this magnificent dragonfly\*, a considerable amount of information has been collected about it. My friend, Mr. E. A. C. Olive, of Cooktown, North Queensland, has paid many visits to the locality where I took the type-male, with the result that he has succeeded in securing a splendid series of males, both of mature and immature colouring, and has at last also captured a perfect specimen of the female. The latter is a most beautiful insect, with a very remarkable scheme of colour-shading on the wings, so that I propose to give, in this paper, a full description of it, supplemented by a figure.

The range of the species has also been extended to several widely separated localities. Mr. H. Elgner has taken it at Cape York, and also at Prince of Wales' Island, Torres Straits. Mr. F. P. Dodd has taken it at Port Darwin. Dr. F. Ris, of Rheinau, Switzerland, who has taken a great deal of interest in this species, informed me that he had lately seen, at Brussels, some old forgotten lots of dragonflies purchased by de Selys shortly before his death. In one of these collections, from the Solomon Islands, he noticed a beautiful *Camacinia* ♀ "which might well be

\*On Some Remarkable Australian *Libellulinae*. Part II., Description of New Species. These Proceedings, 1908, Vol. xxxiii, p.639, Plate xiv., fig.1.

the female of *C. Othello*." For purposes of identification I immediately forwarded to him a photograph of my Cooktown female, together with a description, also offering him the use of both for publication in his great work on the *Libellulina*. In his reply, he identifies the Solomon Island insect as *C. Othello* ♀, but most generously refuses to make use of my description and photograph, on the ground that some trouble might arise as to which female should be regarded as the true type, my specimen or the Solomon Island one. In a later letter, he tells me that he has received from the Frankfort Museum a small collection of dragonflies from the Aru Islands, containing four males and one female of a *Camacinia* intermediate between *C. Othello* and the well-known and widely distributed *C. gigantea* Brauer, a Malayan species. We are thus able to get some idea of the limits of the range of *C. Othello* itself. It would be most interesting to know whether it occurs in North-Western Australia or in Timor. It seems fairly certain that it is the descendant of a somewhat early invader from the Indo-Malayan stock, whose isolation has been sufficiently complete and lasting to have produced a very distinct and definite species. Whether it came in by way of Timor, and travelled eastwards to Port Darwin, and thence to Cape York and Cooktown; or whether it came by the easier route of Torres Straits, and then spread westwards, I do not think we have sufficient data to decide.

It is a most interesting point to notice that, of the great number of *Libellulina* which form the tropical invasion into Northern Australia, very few indeed shew any variation at all from the forms still found in the Islands. One or two forms deserve sub-specific rank only, in Dr. Ris's opinion—such forms as *Agrionoptera allogenes* Tillyard, and *A. regalis* Tillyard; while Australian representatives of *Zyxomma obtusum* Albarda, and *Orthetrum pruinorum* Burmeister, cannot be regarded as more than slight variations from the types. The greater number of species, however, exist absolutely unchanged on both sides of the Straits. We have therefore, in *C. Othello*, distinct evidence of the antiquity of the genus *Camacinia* itself.

The following is a description of the type-female :—

Total length 49 mm.; abdomen 30 mm.; expanse of wings 111 mm.; forewing 49 mm.; hindwing 47 mm.

Head dark shining brown all over, edge of *labrum* and whole of *labium* slightly paler; *eyes* bordered behind with paler brown. Thorax shining brownish. Abdomen short, cylindrical, fairly stout, dark brown with black transverse bands in the sutures and a distinct black line crossing segment 3. Appendages short (1.4 mm) subcylindrical, rather pointed, slightly converging. Wings (see figure) with a beautiful colour-pattern of dark semitransparent brown, as follows :—between the costal and anal veins, from base up to nodus and 4.5 mm. beyond it, and completely filling the subcostal, median and submedian spaces, (though in the costal space the upper half is practically clear, leaving the cross-veins easily visible); the shading also completely covers the hindwing triangle, but not that of the forewing. Besides this, the tips of all four wings are suffused with rich brown nearly to the level of the proximal end of the pterostigma. The venation, as is usually the case in *Camacinia* and *Neurothemis*, is somewhat less complicated than that of the male, especially in the anal loop and surrounding areas of the hind-wing.

*Hab.*—Cooktown, N. Queensland. (Type ♂, December, 1907; taken by myself); type ♀, February, 1910, E. A. C. Olive; 12 ♂♂, February, 1909, 6 ♂♂, February, 1910, E. A. C. Olive; all in the same locality near the Annan River. Cape York (♂♀, October, 1909; H. Elgner). Prince of Wales' Island, Torres Straits (♂♀, September, 1908; H. Elgner). Port Darwin (3 ♂♂, 2 ♀♀, February to April, 1909; F. P. Dodd). Solomon Islands. (♀, date unknown, communicated by Dr. F. Ris).

#### EXPLANATION OF PLATE XVII., FIG. 3.

Fig. 3.—Wings of *Camacinia Othello*, ♀ (x½).



## NOTES ON FRUIT-FLIES (*TRYPETIDÆ*) WITH DESCRIPTIONS OF NEW SPECIES.

BY WALTER W. FROGGATT, F.L.S.

Since the distribution of my Report dealing with these pests (Official Report, 1907-8; Fruit-Flies), I have received a great many letters, and specimens from different parts of the world, where fruit-flies are found; and I have thus obtained a great deal of interesting material to examine for my correspondents.

I am indebted to Mr. C. C. Gowdey, for a fine series of *Ceratitis punctata* from Entebbe, Uganda, where it is a pest upon cocoa. Mr. Dupont, Curator of the Botanic Gardens at Mahi, Seychelles, has sent me *Ceratitis catoirei* bred from oranges. Mr. J. J. Fletcher has obtained a new and very handsome species of *Ceratitis* from the fruits of a West Australian Loranthus. Mr. P. Keenig, Director of Forests and Gardens at St. Louis, Mauritius, sent me a series of *Dacus sigmoides*, the common pest of melons. Mr. H. H. King, of the Gordon College, Khartoum, has sent me several new species from Egypt; and Dr. Roepke others from Java. During my visit to the Solomon Islands, last year, I captured a number of specimens of a species of *Dacus*, identified by Mr. Coquillett as *D. sonatus* Saund., and other specimens of this species were given to me, from Murray Island. I am indebted to Professor Bezzi, of Turin, and to Mr. D. W. Coquillett, of Washington, for the determination of several of my specimens; and to the former, and to Mr. P. L. Lounsbury, of Cape Town, S. Africa, for named specimens. Mr. T. Kirk, of New Zealand, has also sent me some curious forms, obtained from fruit imported from the Pacific Islands.

**CERATITIS LORANTHI, n.sp. A Mistletoe Fruit-Fly.**

Length 6 mm. from front of head to tips of wings. General form and size of *C. capitata*; but the greyish markings on the dorsal surface of the thorax more regularly enclosed in black, the central black blotch and club-shaped markings on either side running up into the greyish area, where they are clearly defined, forming with the scutellum three regular bands.

Basal portion of the wings as in *C. capitata*, but without any yellow or ochreous clouding; the apical two-thirds cut off from the basal area of the wings, with a broad fuscous band which merges into a uniform stripe along the costal margin, from which a second transverse stripe emerges, crossing to the hind edge; beyond this a short finger-like bar turns downward, while the costal stripe extends round the tip of the wings.

Chætotactic characters.—Head: antennæ covered with fine spines; arista long; front with four bristles on either side, a bristle springing out on either side of the lower ocellus; two stout bristles on either side of the vertex, with two stout bristles between them behind the ocelli; a fringe of short spines round the hind margin of the eyes. Thorax: four small bristles on the front margin, five on either side, eight on the dorsal surface, and four on the scutellum.

*Hab.*—Perth, W. Australia. Bred from fruits of *Loranthus pendulus* on *Eucalyptus* sp. (J. J. Fletcher).

The fruits of the *Loranthus* were sent to Mr. Fletcher by Dr. J. Burton Cleland, at that time resident in Perth, as botanical specimens; on examination they were found to be badly infested with fly-maggots; Mr. Fletcher, therefore, kept them under observation, and when they bred out, handed the flies to me for identification. The distinct banding of the wings is quite unlike any other described species of the genus.

**CERATITIS PUNCTATA Wiedm. The Cocoa Fruit-Fly.**

This large, handsome fly was described by Wiedemann from Ashanti, West Africa, in 1824; but was rare and comparatively

unknown in collections until now. Last year(1909), Mr. C. C. Gowdey found this fly doing a great deal of damage to the Cocoa pods, in the plantations at Uganda, and he sent a fine series of specimens to Mr. Austen, at the British Museum, and also to me; we both identified it as Wiedemann's long-lost species. Gowdey has published a leaflet on the cocoa-fly, giving an account of the damage it causes, and its life-history; but he does not give a description of the adult fly.

This is one of the largest species of the genus, measuring up to  $\frac{3}{4}$  inch from the front of the head to the tips of the wings. General colour dull greyish-brown; spotted all over the dorsal surface and abdominal segments with dark brown to black marks, those upon the thorax small, except the three large, shining, black blotches occupying the scutellum. Wings mottled and barred much like those of *C. rubivora*.

Chætotactic characters.—First antennal joint with a fan of fine bristles; face covered with fine scattered bristles, but without large lateral bristles; hind margin of eyes fringed with stouter bristles, eight or more in number. Thorax: each black spot bearing a stout bristle; front margin of thorax with six, two outer ones longest; no bristles on the rounded scutellum. The whole of the dorsal surface of the abdomen clothed with fine bristles, forming a transverse band round each segment, to the sheath of the ovipositor of the female.

*Hab.*—Uganda, E. Africa; attacking Cocoa-pods (Mr. C. C. Gowdey).

#### CERATITIS CATOIREI Guérin. The Mauritius Fruit-Fly.

From the Seychelles Islands, I have a female specimen of a *Ceratitis* which was obtained by Mr. Dupont, Director of the Botanical Station at North Mahi, from a Tangerine orange.

It agrees in colouration and size with Guérin's description of *C. catoirei*, which was described from Mauritius as damaging oranges.

Chætotactic characters identical with those of *C. capitata*. Head: four bristles on either side of front, one on

either side of the lower ocellus, two on each side of the vertex behind the angle of the eye, with a fine fringe of bristles round the hind margin of the eyes. Thorax: five on each side of the thorax, a row of three on either side of the dorsal surface, with four in the centre, the lower pair reaching over the scutellum, which is furnished with four long bristles.

**DACUS TRYONI Frogg. The Queensland Fruit-Fly.**

Some interesting points have been worked out in the life-history of this species, through the experimental work carried out by Mr. W. B. Gurney at Narara. While non-existent, last season, in the orchard-fruits, a great number of the indigenous, succulent-fruited scrub-trees, such as the Black Apple (*Sideroxylon* (*Achras*) *australe*), the Cheesewood (*Acronychia* *lævis*), and the White Ash (*Schizomeria* *ovata*) were found to have their fruits badly infested with the larvæ of this fruit-fly. These trees were often growing in belts of scrub along the gullies adjacent to the orchards, yet the fruit-flies did not spread away from the indigenous fruits. This tends to show that this fruit-fly is a native of the coastal districts of New South Wales as well as Queensland, ranging as far south as Gosford, fifty miles north of Sydney; but it is confined to the rich brush-lands upon which these succulent-fruited, forest-trees and shrubs grow.

A small, red, braconid parasite, closely allied to a braconid wasp (*Cratospila* *rudibunda*), the parasite of the Mexican fruit-fly, *Trypeta* *ludens*, has been bred from the fly-larvæ infesting these wild fruits: and, as might be expected, the smaller fruits have yielded the larger per centage of parasites. In the case of the small White Ash berries, 50 per cent. of the fly-pupæ collected contained parasites. Though there appears to be little hope that these parasites will be of any commercial value in destroying the Mediterranean fruit-fly, in such fruits as oranges and peaches, it may be valuable in dealing with the olive-fly of Italy; and we propose, this coming season, to ship quantities to that country, for experiments in this direction.

*DACUS CUCUMIS* French.

Journ. Agric. Victoria, May, 1907.

French proposed this, as a varietal name of a fly, bred from cucumbers imported into Victoria from North Queensland. I submitted this with other species to Dr. Bezzi, of Turin, and Mr. Coquillett, of Washington, who both consider it to be a good species.

This last year, a large number of specimens were obtained from shipments of cucumbers condemned at the port of Sydney, which had been grown in Mackay, Queensland. The distinctive characters in which it differs from *Dacus tryoni* are, a somewhat uniform lighter colour; a short yellow dorsal stripe down the centre of the apical half of the thorax, but not reaching to the basal margin of the scutellum; and four bristles on the apical margin of the scutellum.

In *Dacus tryoni* there is a row of four bristles along the apical margin of the thorax, behind the scutellum, and only two bristles on the apical margin of the scutellum.

*DACUS FRENCHI* Frogg.

This species was described from a specimen obtained from Mr. C. French, Government Entomologist of Victoria, who bred it from oranges, from New Caledonia.

Among some fruit-flies sent to me by Dr. Roepke, of Java, were four male specimens of an undetermined species, that proved, on careful comparison with the type, to be the other sex of this species (the type being a female). The only difference is in the shape of the abdomen, which is elongate and somewhat spindle-shaped in the male.

This fly, therefore, must have a very wide range, if found in New Caledonia and Java. Dr. Roepke's specimens were bred from the fruits of *Artocarpus integrifolia*.

*DACUS KINGII*, n.sp.

♂. Length, 8 mm.; ♀. 11 mm. to tip of ovipositor. More slender in form than usual; thorax narrow, truncate in front, broadest

across the base of wings; wings hyaline, with a faint blotch of fuscous at tips. Abdomen somewhat cylindrical, rounded at apex; that of the ♀ furnished with a slender tubular ovipositor, projecting beyond, and as long as the abdomen. Dorsal surface of thorax clothed with long silvery pubescence, that on the abdomen golden.

Head yellow; eyes chestnut; two black spots below the antennæ, four on front between the eyes and the blotch round the ocelli black. Thorax dark reddish-brown, the pubescence giving it a greyish tint; humeri, a lateral stripe on the pleura, meeting the slender wedge-shaped stripe, coming up the median suture, well into the dorsal surface, a double rounded blotch on the hypopleura, a short wedge-shaped stripe in the centre of back in line with centre of the scutellum, pale yellow. Legs yellow, with the exception of a broad band of reddish-brown on the apical half of the femora. Abdomen light reddish-brown; lightly clothed with golden pubescence, and banded with pale yellow.

Chætotactic characters.—Two pairs of bristles on front between the eyes, a large one on either side of the vertex, with a smaller one on either side behind the eyes. Thorax with short bristles on the front margin, and on either side; scutellum carrying a pair.

*Hab.*—Khartoum, Egypt (Mr. H. H. King, Entomologist, Wellcome Research Laboratories, Gordon College). Bred from the fruits of the Usher-tree (*Calatropis procera*).

#### DACUS SIGMOIDES Coqu.

This species was described by Coquillett, from one female specimen, from Mauritius.

Mr. P. Keesig, Director of the Botanical Station at Mauritius, sent me four specimens of a fruit-fly, very destructive to melons; this agrees with Coquillett's description.

These specimens vary much in size, and in the black and yellow markings on the dorsal surface of the thorax; one has the short yellow stripe between the two black bars; others have the

yellow dorsal stripe wanting; and, in another, the black bars are hardly outlined on the thorax.

*DACUS ZONATUS* Saunders.

*Dasyneura zonata* Saund., Trans. Ent. Soc. iii. pl.v., f.3, 1841.

Length 10 mm.

Head ochreous; eyes chestnut; antennæ large, apical joint brown; arista long and slender; two black spots below the antennæ, with blotch above, three spots on either side of the front, and a central blotch encircling the ocelli clouding the vertex. Thorax black, clothed with fine silvery pubescence; on either side of the dorsal surface a short elongate yellow stripe, broadest in front and tapering to a point behind; humeri large; a nude area on mesopleura, with a wedge-shaped one above not reaching the dorsal surface of the median suture; a double rounded blotch on hypopleura; scutellum bright yellow. Legs yellow, tibiæ of hind pair clouded with brown. Wings hyaline; with the costal margin and stripe across the basal portion brown. Abdomen ochreous, with golden pubescence; basal segment, a broad marginal band on 3rd-5th segments, and a slender dorsal stripe from base of 2nd segment reaching to the tip of the abdomen, black.

Chætotactic characters.—Head: each of the six frontal spots bearing a black bristle, four on the vertex, and a fringe of small ones behind the eyes. Thorax: four bristles on the front margin, central ones smallest, six on either side, and two on hind margin of scutellum.

*Hab.*—Bainka, Russell Group, Solomon Islands (Messrs. McKenzie and Froggatt); Ceylon and India (in mango gardens); Murray Island.

About thirty specimens, all males, were taken in an open glade in the forest, by sprinkling the foliage with a citronella oil mixture; until the oil was used, no specimens were seen. One female specimen was taken with a sweeping net, on the edge of the forest; it differs from the male in having darker-coloured legs, and in the whole of the abdomen, with the exception of the basal reddish band, being black.

In a paper entitled "Four new Dipterous Insects from Central and Northern India," Saunders proposed the genus *Dasyneura* for the reception of this fruit-fly. I am indebted to Mr. Coquillett for identifying my species from the Solomon Islands, as the one found in Central India, so many years ago.

It is very variable in the colouration of the abdomen, but the dorsal stripe on the lower half of the abdomen is constant, if at times indistinct. Saunders describes the general colour as "reddish-brown," but the dorsal surface of the thorax of all my specimens from India, Ceylon, and the Solomon Islands, is decidedly black, with silvery pubescence.

*DACUS PEPISALÆ*, n.sp.

♂. Length 12 mm.

Head ochreous; eyes dark reddish-brown; antennæ mottled with black; arista black; two large spots below the antennæ, a blotch on the front above, which envelops the first pair of lateral spots, two spots on either side above, and the area round the ocelli, black. Thorax black, with an indistinct pattern of silvery pubescence on the dorsal surface; humeri small, yellow, in contact with upper edge of nude area on mesopleura, which extends to the base of the middle trochanters; a small wedge-shaped nude yellow area in the median suture on either side joins a dorsal stripe on the sides of the mesothorax, which does not reach the hind margin; a double oval patch on either side of the hypopleura bright yellow; scutellum ochreous; truncate at apical margin. Legs yellow, mottled with brown. Wings large, clouded so thickly with yellowish-brown that only the first basal cell, a transverse stripe behind it, the centre of the first posterior and the anal cell are transparent. Abdomen ochreous, covered with fine golden pubescence; the whole of the first segment, a fine broken band across the second, and the outer third of the sides of the third and fourth with a fine central stripe, and the whole of the anal segment, black.

Chætotactic characters.—The dark reddish-black blotch on the front above the antennæ is convex, and covered



with short black bristles, with three pairs of lateral bristles on the front and two above the ocelli on either side. Thorax : no bristles on the front margin, but a tuft of fine hairs on each shoulder; lateral bristles five in number, and two scutellar bristles.

*Hab.*—Russell Group, Solomon Islands; one male, caught with a sweeping net, on the edge of the forest(W. W. Froggatt).

*DACUS PASSIFLORE*, n.sp.

Length 9 mm.

Head dull yellow; mouth-parts and antennæ darker, terminal joint of latter large; arista long, slender; eyes dark red; a lunate dark blotch above the antennæ, front unspotted, dull brown; ocelli enclosed in an angular black blotch. Thorax black, no yellow on shoulders, the large angular nude area on mesopleura not reaching the dorsal edge, yellow; scutellum narrow, convex, dull yellow; double yellow spots forming a blotch on hypopleura. Wings hyaline, nervures chocolate-brown. Legs light yellow, sometimes clouded at the apex of the femora, tibiæ, and tarsi. Abdomen black, elongate, oval; in the female the basal segment is broadly rounded, with the anal segments and ovipositor turned down right under the basal portion; sheath of ovipositor large, apex yellow.

*Chætotactic characters.*—Head: three pairs of bristles on the front, the first pair longest, crossing each other at the tips; the third pair below the ocelli shorter; apex with a pair of stout bristles on either side. Thorax: bristles on front margin short, four on either side, with a pair on the dorsal surface above the scutellum, the latter furnished with a pair on the hind margin.

*Hab.*—Fiji(W. W. Froggatt; bred from *Granadilla*-fruits); (A. Koebele; bred from mangoes); (T. Kirk; from fruit imported into New Zealand).

*DACUS TONGENSIS*, n.sp.

Length 9 mm., across outspread wings 12½ mm.

Head ferruginous; eyes reddish-chestnut; apical joint of antennæ fuscous; two black spots below antennæ, a blotch round

their base and back of head, black. Thorax: dorsal surface black; with silvery pubescence forming indistinct bands; humeri small, well down the sides; nude area on mesopleura forming a narrow stripe not extending to the dorsal surface; two rounded spots on hypopleura, and the narrow convex scutellum yellow; apical portion behind the scutellum forming a distinct, black, square patch marked off by the scutellum above, and the yellow blotches on either side. Wings hyaline, nervures brown. Legs straw-yellow, darkest at junction of femora and tibiæ. Abdomen of male spindle-shaped, broadest in the centre, tapering to apex; of female much broader, anal segment narrow truncate, with the sheath and ovipositor reddish. General colour ochreous, mottled with black, forming an irregular dorsal stripe, with a lateral one on either side, and the extremity black.

Chaetotactic characters as in *Dacus passifloræ*.

*Hab.*—Tonga (T. Kirk; bred from mangoes imported into New Zealand).

*DACUS KIRKI*, n.sp.

Length 8 mm.

Head reddish-brown; two large black spots below the antennæ, spots on front very slight, hardly showing; a small blotch enclosing the ocelli and back of head blackish, terminal joint of antennæ fuscous. Thorax black, shaded with silvery pubescence, forming a broad well developed dorsal stripe in the centre, with the sides irregularly frosted; humeri well down the sides, small, and almost oval; nude area on the mesopleura forming a stripe on the side, not reaching above the insertion of the wings, yellow; scutellum angular, black on the upper surface, with the extreme margins and undersurface yellow, joining a broad yellow stripe on either side of the hypopleura. Wings hyaline, nervures brown. Legs pale yellow, mottled with brown, femora reddish-brown, tibiæ darker. Abdomen elongate-oval or heart-shaped, black, with two parallel yellow stripes separated from each other by a narrow black dorsal stripe running down to the tip; ovipositor small, undersurface yellow.

Chaetotactic characters as in *Dacus passifloræ*, except that there are four bristles on the hind margin of the thorax, two behind the scutellum and one on either side.

*Hab.*—(?) Bred from Island fruit imported into New Zealand (T. Kirk); bred also from peaches.

#### DACUS RAROTONGÆ, n.sp.

Length 9 mm.

Head ochreous, blotch round the ocelli and back of head black, eyes dark brown. Thorax shining black; humeri small, nude area on mesopleura large and angular, with a rounded blotch on each side of the hypopleura pale yellow; scutellum black. Wings hyaline, nervures light brown, slightly fuscous on the costal edge. Legs fuscous, hind pair almost black. Abdomen of male oval, pointed at apex; of female almost diamond-shaped, angular on the sides, sloping down from the middle to the small truncate apex; anal segment and ovipositor yellow. Dorsal surface of thorax and abdomen covered with fine scattered grey pubescence.

Chaetotactic characters.—Head similar to that of *D. passifloræ*, with the addition of a pair of short bristles on the sides of the lower ocellus. Thorax with two bristles on either side of front margin; five on either side above scutellum, two short bristles with a longer one on either side; scutellum with a pair of long bristles.

*Hab.*—Rarotonga [Cook Islands] (T. Kirk; bred from mangoes).

#### RIOXA (TRYPETA) MUSÆ Froggatt.

Professor Bezzi, to whom I sent specimens of this and other Australian fruit-flies, informs me that this species, which I referred to the genus *Trypeta* in my original description, should be assigned to *Rioxa*, which contains about half-a-dozen species, confined to the Malay Islands. He says of it: "A distinct form from all the other species of *Rioxa*, distinguished by the wholly black stigma on the wings."

CONTRIBUTIONS TO A KNOWLEDGE OF THE  
ANATOMY AND DEVELOPMENT OF THE  
*MARSUPIALIA*.

No. i. THE GENITALIA OF *SARCOPHILUS SATANICUS* (♀).

BY T. THOMSON FLYNN, B.Sc., LECTURER IN BIOLOGY,  
UNIVERSITY OF TASMANIA.

(Plates xxvi.-xxxi.)

*Introductory.*—The specimen of *Sarcophilus satanicus*, of whose genital organs this communication is a description, was forwarded to me through the kind offices of Mr. J. E. C. Lord, of Hobart, in August, of last year. I wish also to express my indebtedness to several other gentlemen, notably Mr. W. Stops, and Dr. J. S. C. Elkington, for their endeavours to obtain specimens for this work. This is the only female which I have as yet obtained, and I had originally intended that its description should wait until further specimens had come to hand; the increased scarcity, however, of these animals, together with the discovery of a number of interesting and significant points in the morphology of the genital organs, has influenced me to publish the results earlier than otherwise would have been the case. Portions of the paper can as yet be regarded only as preliminary notes. This is due, in the first place, to scarcity of material, and, in the second, to an unfortunate lack of original communications and papers in Tasmania. I have had to depend on my friends, especially Professor Haaswell and Acting-Professor Johnston, of Sydney, to remedy somewhat my deficiencies in this respect, and I here take the opportunity of thanking them sincerely for the help they have given me.

*Description of specimen.*—The specimen was a full-grown female, with three fairly advanced young in the pouch. All had

been dead for two days. The pouch-young were fixed entire in corrosive-sublimate-acetic-solution, the genital organs of the mother in micro-sulphuric solution. In this latter case, on sectioning, it was found that what blood there was in the vessels had hardened so much, that it was only with extreme care and difficulty that sections could be cut at all. The hopeless gapping of the razor-edge, with consequent damage to the sections, is well indicated in Fig.10.

The present paper consists of two parts. One is a description of the genital organs of a pouch young measuring 65 mm. in greatest length, not meant to be exhaustive, but merely for comparison with the adult organs; the other contains an account of the adult genital organs.

i. ON THE GENITAL ORGANS OF A 65 MM. POUCH-YOUNG OF  
*SARCOPHILUS SATANICUS*.

*External features of embryo.*—Measurements: H.L. 33·5 mm.; snout to root of tail (along dorsal curvature) 90 mm.; tail 20·5 mm.; arm 25 mm.; leg 21 mm.; foot 10 mm.

Body seemingly naked, but really covered with minute, very fine hairs; of the general body-hairs those on top of the head, snout, and back are rather longer than others. There are well-developed vibrissæ (8 mm. in length); there are about eight strong hairs above the eyes, and twenty in a patch below and behind them. On the shut and united eyelids, eyelashes are fairly well developed. A small bundle of eight or nine specialised hairs is placed on a small elevation on the postero-internal side of the arm. The leg is devoid of special hairs. The lips are quite united, as well as the eyelids. The ear-pinna is quite free, and directed backwards. The umbilical scar is almost obliterated. The marsupium consists of two contiguous deep sacs, with test-rudiments. Clitoris visible, and external. Limbs well developed; fore-limb with five clawed digits, first shortest, third and fourth longest, second and fifth equal and intermediate; hind-limb with four equal toes.

The embryo seemingly corresponds, in age, with the late mammary foetus of *Trichosurus vulpecula*, figured by Broom(2, Fig.14), of which he says it "differs but little in its character from the adult."

*Genital Organs.*—These are shown in Fig.2. In external appearance their arrangement is similar to that of similar organs in the adult(Fig.1). The ovaries are small, compressed, oval bodies, quite smooth, with a length of 2 mm., and a breadth of 1.5 mm. Stretching back from the ovaries are visible the two genital cords, containing the Müllerian ducts and vestiges of the Wolffian ducts, here confined to a short, blind passage from the genital cord, through the mesoarium, and ending blindly in the substance of the ovary. The genital cords pass back to meet dorsally to the bladder. Between the Müllerian ducts pass the ureters, to enter the bladder; and shortly after this, there is formed, for a short distance, what Hill(3) has called, in the adult *Perameles*, the urogenital strand, containing as it does the vaginal portions of the Müllerian ducts and the urethra. A little behind this, however, the two Müllerian ducts open into the urogenital sinus, which is directly continuous with the urethra. Most of the cylindrical mass of tissue, then, seen in Fig.2, posterior to the bladder, is not urogenital strand, but the enclosing tissue of an extremely long and narrow urogenital sinus. It measures 6 mm. long, by an external width of from 1.2 mm.

*Microscopic Structure.*—The Ovaries: sections show that the differentiation into primitive ova and follicular cells is just in progress. The Müllerian ducts are contained in the genital cords. Each duct is a fairly convoluted tube opening, in front, into the abdomen by the ostium abdominale tubae, and behind into the urogenital sinus. The anterior portion of the duct has an average breadth, in section, of 0.072 mm. The uterine portion of the duct is much enlarged to form the *anlage* of the uterus. This enlargement is not visible externally. When the two genital cords come together dorsally to the bladder, where the two cords almost completely fuse, the two Müllerian ducts remain quite distinct, separated by a wall of connective-

tissue averaging 0.19 mm. in thickness. Farther back (Fig. 4), the Müllerian ducts (*l.vag.c.*) are now seen to diverge gradually, but between, is a mass of connective tissue (*x*) which soon remains stranded between them, as shown in Fig. 5, where the Müllerian ducts (*l.vag.c.*) are now seen to be still more separated. This deeply staining mass of connective tissue (*x*) gradually disappears in sections, lasting, all told, through 80. It is the indication, in the embryo, of the future median vaginal cul-de-sacs (and possibly of a portion of the pseudovaginal passage), passing, as it does, backwards from the point where the Müllerian ducts begin to diverge posteriorly.

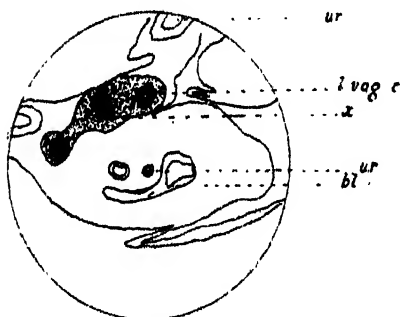


Fig. 4.

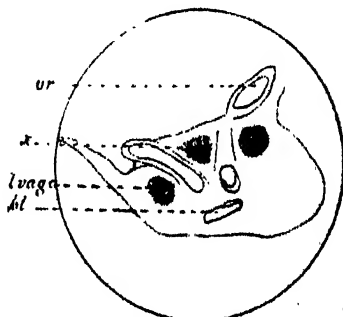


Fig. 5.

The two Müllerian ducts now approach one another, and come to lie parallel in the narrow cylinder of tissue continuous with the connective tissue enclosing the urogenital sinus, and known as the urogenital strand. Each measures on an average 0.057 mm. in diameter. Twenty-eight sections after the disappearance of the connective tissue (*x*), they open into the urogenital sinus, as shown in Fig. 6.

The urogenital sinus has a very definite lumen, with a number of longitudinal grooves; two of these are dorsal or dorso-lateral, one is ventral, the others are ventral or ventro-lateral. The two lateral vaginal canals open into the right and left dorsal grooves. Owing to an accident, the whole of the clitoris could not be

sectioned. The portions seen, however, showed the median septum, and the two lateral septa, with a semicircular mass of erectile tissue arranged round the latter, much as is found in the adult *Phascolarcios*.

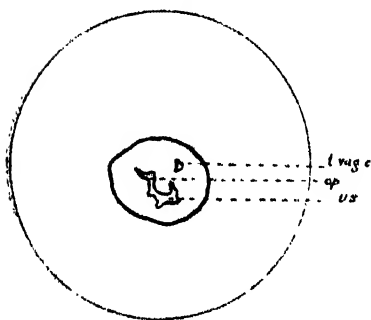


Fig. 6.

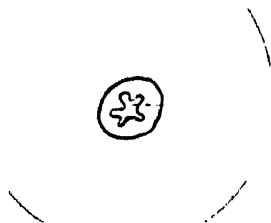


Fig. 7.

ii. ON THE ANATOMY OF THE GENITAL ORGANS OF AN ADULT FEMALE *SARCOPHILUS SATANICUS*, WITH THREE ADVANCED POUCH-YOUNG.

*External appearance of the Genital Organs.*—The genital organs are shown in Fig.1. They comprise two ovaries, two Fallopian tubes, two uteri, the median vaginal apparatus, two vaginæ, and a long urogenital sinus. A general glance at Fig.1, and a comparison of the figure with Hill's drawing of the genital organs of *Perameles*(3, Fig.1) would give rise to the impression that in *Sarcophilus*, as in *Perameles*, there is present an elongated strand of tissue, the so-called urogenital strand. But this is not so. Sections show that the long cylindrical mass of tissue(*u.s.*) seen in Fig.1, is almost entirely the wall of an elongated urogenital sinus, only the most proximal portion of this tissue representing the urogenital strand. But there is an important point of agreement between the genital organs of *Perameles* and *Sarcophilus*, which needs to be fully emphasised; in both we have, in the adult, a condition of the genital organs characterised by Hill(3) as "persistently embryonic," inasmuch as the posterior



portions of the Müllerian ducts, together with the median vaginal apparatus, remain permanently embedded in the tissue extending between the median vaginal canals and the urogenital sinus, —the persistent genital cord.

Another point, to which I wish to draw attention here, is the sharp division of the uteri into body and neck. In the figure (Fig.1) the bodies of the uteri can be plainly seen (*r.ut.*). The canals leading posteriorly from these gradually converge and meet. They are the uterine necks, and, just after meeting, each presents a distinct os, which in this case does not project into the cavity of the corresponding median vaginal cul-de-sac, but into a short canal continuous with the uterine neck, which itself leads to the median vaginal cul-de-sac, and which, for the time being, I have named the median vaginal neck.

The Ovaries (Fig.1, *r.ov.*) are situated in the abdominal cavity, some distance in advance of the pubic symphysis. They are somewhat compressed oval bodies, with the long axis oblique to the long axis of the animal. In this specimen, they measure in length 7.5 mm., in breadth 5 mm. The surface is almost smooth and finely granulated. The direction of the long axis of the ovary to the long axis of the animal is by no means constant on different sides of the same animal, as Fig.1 indicates. In *Perameles* the ovaries are situated dorsally to the uteri. In *Sarcophilus* they are placed well in front (distant about 10 mm.) of the uteri. The ovaries are widely separated from one another, and are fully visible in the natural condition of the parts. Between them stretches the median, united portion of the broad ligament. To this, the ovaries are attached by thickened, upward invaginated portions.

Of the ovaries of *Perameles*, Hill says, ". . . they lie enclosed, together with the fimbriated openings of the Fallopian tubes, in peritoneal pouches formed by the broad ligaments. The pouches lie dorsal to the uteri, and open posteriorly by wide apertures into the dorsal uterine fossa."<sup>(3)</sup>

In *Sarcophilus*, on the other hand, the ovaries are not contained in any pouches, but are freely and fully visible from above.

However, immediately behind the ovaries there is a downwardly directed pouch-like invagination of the broad ligaments, 4 mm. in depth. The mouth of each invagination is directed upward and mesially. In the outer wall of this invagination run the ovarian ligament, and also the round ligament for a portion of its course. These two ligaments arise from the uterus in such close combination as to form a single ligament, the two shortly separating.

The Fallopian Tubes (Fig. 1, *f.t.*) are rather peculiar in not being greatly convoluted. They are thin, but well defined tubes sharply marked off from the uteri behind, and extending almost in a straight line, without any great convolution, forward to become expanded and fimbriated. The fimbriae only slightly invest the ovary. In their course between the ovaries and uteri, the Fallopian tubes have to pass through the above-mentioned pouches, dipping down in the anterior wall traversing the floor, and rising again before each expands to form the uterus.

Uteri.—These (Fig. 1, *u.t.*) have a peculiar shape, which, however, is quite comparable with the shape of the similar organs in *Perameles*. Each is many times longer than wide, and is divided into two portions, a "body" and a "neck." The two portions are quite sharply and distinctly marked off from one another. While in *Perameles* "the two bodies of the uteri lie with their mesial surfaces in apposition, except anteriorly where they are separated over a short part of their extent and connected by the common median portion of the ligamenta lata" (3), in *Sarcophilus* they are completely separated from one another by a considerable space occupied by the common forward and median expansions of the broad ligaments. Each body has, in external view, the inner side flatter in shape than the outer; and in section the uterus is subtriangular, with the flat inner side perpendicular, and the dorsal and ventral surfaces meeting at a somewhat blunt angle on the outer side of the uterine body. The dimensions of the uterine body are, length 14 mm., greatest breadth 6 mm.

Microscopic Structure of the Uterus.—This is similar to that described by Hill, for *Perameles* (5). The serous

layer is practically uniform in thickness (0.08 mm.) except at the two points where the broad ligaments become continuous with it, where it is much thickened. Within the serous layer is the muscular layer composed entirely of plain, circularly running fibres. Blood-vessels pass from this layer into the mucous layer, and penetrate to a point just below the inner epithelium. The mucous layer is characteristically disposed. On the two sides where the broad ligament becomes continuous with the serous layer, the mucosa is much thickened, forming two large cushion-like projections into the lumen of the uterus, measuring in thickness 1.1 mm.; on the dorsal and ventral sides of the uterus, however, the mucosa becomes much reduced in thickness, measuring only 0.19 mm. The uterine glands, even at this stage, are somewhat smaller than in the virgin *Perameles*, having a very small lumen, measuring from 0.016 mm. to 0.035 mm. in diameter. The mucous membrane is covered by a columnar epithelium measuring, in thickness, about 0.027 mm.

**Uterine Necks.**—These (Fig. 1, *ut.n.*) resemble externally the Fallopian tubes. Each is quite distinct from the uterine body. Internally the surface of each uterine neck is raised into folds and ridges. Each neck ends in a distinct os, some distance anterior to the point where all the ducts become blended into one mass. The two necks approximate, and run side by side, separated by a wall of connective tissue 0.506 mm. in thickness, which, further back, decreases, by further approximation of the necks, to 0.476 mm. Each os is extremely well defined, and of large extent, differing markedly in this respect from the similar structure in *Perameles*. The os of the left uterus extends through eighty sections of medium thickness.

**Median Vaginal Apparatus.**—This consists, on each side, of a median vaginal cul-de-sac, which is quite distinct from its fellow of the opposite side, and separated from it by a thick, complete partition-wall. The right median vagina is considerably larger than the left. The whole arrangement of the median vaginal apparatus is irregular. Each of the median vaginal cul-de-sacs is a large, irregular chamber of no defined shape. The

method of entry and exit of the ducts leading to and out of each median cul-de-sac, varies on each side, and seems to be arranged on no settled plan. Leading from the uterine necks, posteriorly to each os, is a fairly wide canal, which is, seemingly, quite distinct, in this specimen, from the median vaginal cul-de-sac. This is to be regarded as an anterior portion of the vaginal section of the Müllerian ducts, which has not entered into the formation of the cul-de-sacs proper. Pending further enquiries into the relationship of this canal in the virgin, I have called it, for the time being, the median vaginal "neck." The vaginal necks on either side have a quite different arrangement. On the left side, eighty-three sections behind the point where the os ends, there appears, a short distance outside the left vaginal necks, a couple of small cleft-like openings which soon coalesce and enlarge, forming an irregular chamber, the left median vaginal cul-de-sac. The shape of the chamber is indefinite, but it is lined by a well marked epithelium, the cells of which contain large rounded nuclei. Further back the arrangement is as seen in Fig.8. The left median vaginal cul-de-sac is now a long, low chamber, from which, on the outer side, is being separated off a portion to form the lateral vaginal canal, this being recognised by the longitudinal foldings and corrugations in its walls. This latter soon becomes separated from the left median cul-de-sac as a distinct duct. Just anterior to the sections shown in Fig.8, there has appeared, on the inner ventral side, a number of irregular spaces which soon coalesce to form the large, irregular chamber shown in Fig.8(*r.m.v.c.*). The position in which these spaces first appear, is at the inner lower angle of the chamber (*r.m.v.c.*) shown in that figure. The point of exit of the right lateral vaginal canal is shown by the foldings appearing at the lower outer angle of this chamber. Soon the right lateral vaginal canal becomes quite separated from the corresponding median cul-de-sac of that side. The irregularity of the whole arrangement can be seen if it be noted that, in the case of the *left* median vaginal cul-de-sac, the so-called median vaginal neck enters it from the *inner* side, while the lateral vaginal canal exits from

it on the *outer* side; on the *right* side, the median vaginal neck enters the cul-de-sac from its *outer* side, and leaves it by the *outer* side.

The peculiar and irregular arrangement indicated here, points to one of two conclusions.

(i.) That, in this Marsupial, the median vaginal cul-de-sacs are not present in the virgin, and that they are mechanically caused by the resting of the embryos in their course outwards; or, which is more probable,

(ii.) That the enlargement of the median vaginal cul-de-sacs, if present in the virgin, is not a result of conception, but a mechanical result of the passage of the embryo itself.

Of these, the first is virtually disproved by the presence of the epithelial lining to the median vaginal cul-de-sacs.



Fig. 8.

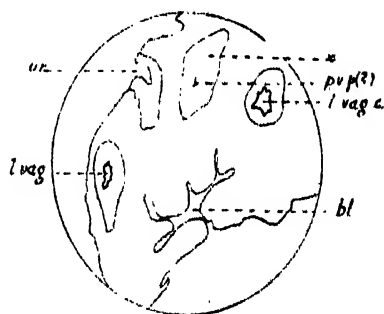


Fig. 9.

We have now in section, therefore, two median vaginal cul-de-sacs lying side by side, but separated by a fairly thick wall, which becomes still thicker further back. Posteriorly the median cul-de-sacs terminate blindly in irregular spaces similar to those in which they began. There is no sign of any inter-communication between the vaginal cul-de-sacs, the intervening partition being quite complete and unperforated. A study of Fig. 9, some sections behind Fig. 8, shows that this form exhibits, in common with *Perameles*, that primitive arrangement in which the posterior

portions of the Müllerian ducts remain permanently embedded in the persistent genital cord of the embryo. In the position where the median vaginal cul-de-sacs disappear, there remains, occupying the central portion of the cord, a mass of deeply staining tissue, in the lateral portions of which the lateral vaginal canals are enclosed. Sectioning further back, the lateral vaginal canals are found to diverge and lose connection with this central mass of tissue. They soon come to lie at the surface, and the central, deeply staining mass has become of rhomboidal shape, as shown in Fig.9, where are also seen, between this mass and the lateral vaginal canals, the inpassing ureters.

The divergence of the lateral canals is still greater in Fig.10, somewhat behind Fig.9, and the central mass has still further changed its shape, as shown in the figure. After the ureters have entered the bladder, the lateral vaginal canals quickly converge, to enter the short cylinder of tissue continuous externally with the wall of the urogenital sinus, and corresponding to the urogenital strand of *Perameles*. The lateral vaginae now come again into relation with the central mass, and, shortly after this, become quite obliterated without any lumen. These

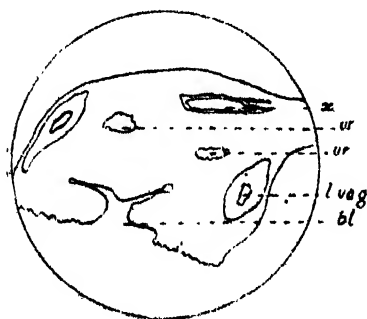


Fig. 10.

closed canals can be seen to come into relation with the urogenital sinus. The deeply staining mass above spoken of (x) represents the path of the pseudovaginal passage. The presence of this passage is indicated by various breaks or splits in the tissue, some of which extend through a considerable number of

sections. At the anterior and posterior ends, however, the passage has quite healed up. The central mass (x) comes into relation with the lateral vaginal canals at the point where these canals become

obliterated. A section in this region is shown in Fig. 11, where the obliteration of the canals can be well seen. In Fig. 12, the portion of the urogenital sinus into which the lateral vaginal canals would open in their functioning condition, is shown. Its irregular and torn shape will at once be noted. It should be compared with Fig. 6, showing an exactly similar section of the urogenital sinus of the embryo. The urogenital sinus is extremely long, measuring 42 mm. in length. It opens into the cloaca on the ventral side. The clitoris is bifid at the extremity, and attached throughout nearly its whole length.

The cloaca is a large, well marked chamber. A pair of anal glands is present

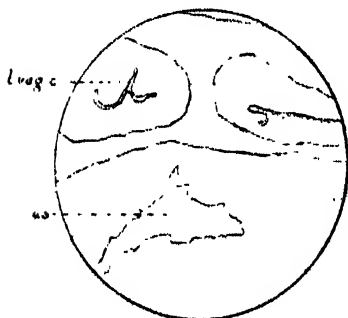


Fig. 11.

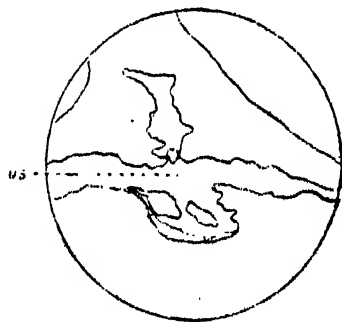


Fig. 12.

**Parturition.**—The arrangement of the urogenital organs in *Sarcophilus* points to the fact that parturition occurs through the medium of a direct median passage which is only temporary, but the track of which is shown by the elongated mass of deeply staining, connective tissue situated axially in the persistent genital cord. Throughout the greater part of its extent, the passage becomes obliterated, but here and there the traces of it can be seen; and, at the posterior end, the obliterated remains of the lateral vaginal canals come into relation with the urogenital sinus, along a long, dorsally situated, deep fissure which, in my opinion, is undoubtedly caused by the breaking of the embryos

from the pseudovaginal passage into the sinus. There is evidence of a considerable tearing and breaking of the tissues in this region. Figs. 11 and 12, representing sections through this region in the adult, should be compared with Figs. 6 and 7 of the similar regions in a well advanced pouch-young. In Figs. 6 and 7, the urogenital sinus is of definite contour, and the lateral vaginal canals (Müllerian ducts) are quite open, definite canals plainly to be seen entering the urogenital sinus. In Figs. 11 and 12, the urogenital sinus is seen to be considerably torn and partially filled with corpuscular debris. The dorsal fissure shown in Fig. 12 comes into direct relation, in the section, with the left vaginal canal. There is also noticeable in this region a considerable quantity of extravasated blood. The obliteration of the hinder ends of the lateral vaginal canals, in my opinion, can only be caused by the embryos meeting them in their course backwards and outwards, and actually tearing them away, or so compressing them that they lose their identity. Although in the specimen, the young are fairly well advanced, yet the lateral vaginal canals have not been able to regain their functional condition. Repair, then, must be exceedingly slow, and for a considerable time after parturition the lateral canals must be functionless, as carriers of the spermatozoa. Such a condition of the lateral canals, consequent upon parturition has, so far as I know, never yet been noted for any marsupial.

*General Remarks.*—Though conclusions drawn from the result of an examination of one specimen are, in many cases, apt to be premature, yet *Sarcophilus* presents, in the morphology of the female genital organs, a number of features of special interest, to which it is necessary that attention be drawn.

The arrangement of its female genital organs is undoubtedly primitive—the presence of the persistent genital cord, the complete separation, even after parturition, of the median cul-de-sacs, the large and definite cloaca all prove this—but whether it is as primitive as such a form as *Perameles*, is not so capable of proof. There is, on the one hand, an absence of any specialized structures, such as the larger vaginal caeca of *Perameles*; but, on the other,



the presence of distinct ora separating the uterine and vaginal segments of the Müllerian ducts, and an elongated urogenital sinus are points in which the genital organs of *Sarcophilus* are relatively more advanced than those of *Perameles*. At present, I will content myself, for the purposes of this paper, with merely briefly pointing out above these points, reserving discussion, at a greater length, for the future, when a larger number of specimens have been examined.

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### EXPLANATION OF PLATES.

#### Reference letters.

*bl.*, bladder—*b.lig.*, broad ligaments (anterior common expansion)—*cl.*, clitoris—*fm.*, fimbriae—*l.vag.c.*, lateral vaginal canal—*l.m.v.c.*, left median vaginal cul-de-sac.—*op.*, opening of lateral vaginal canal into urogenital sinus—*pv.p.*, pseudovaginal passage—*r.m.v.c.*, right median vaginal cul-

de-sac—*r.ov.*, right ovary—*r.ut.*, right uterus—*u.n.*, uterine neck—*ur.*, ureter—*u.s.*, urogenital sinus.

*Note.*—The text-figures are tracings of Figs.4-12, and each is numbered according to the figure from which it is taken. Figs.4-12 are reproductions of photo-micrographs of sections, taken with Leitz's apparatus, using incandescent gaslight.

Plate xxvi.

*Sarcophilus satanicus.*

Fig. 1.—Female urogenital organs of adult, from dorsal aspect ( $\times 1$ ).

Fig. 2.—Genital organs of 65 mm. mammary fetus (female), from the dorsal aspect ( $\times 2$ ).

Fig. 3.—Mammary fetus, measuring, in greatest length, 65mm. ( $\times$  about  $1\frac{1}{2}$ ).

Plates xxv.-xxxi.

Figs.4-12.—See explanations in the text, and also text-figures.

The Meeting concluded with an exhibition of very interesting lantern-slides, shown by Mr. A. R. McCulloch, illustrating the experiences of a naturalist during a recent visit to the New Hebrides.

## SPECIAL GENERAL MEETING.

DECEMBER 21st, 1910.

Mr. C. Hedley, F.L.S., President, in the Chair.

*Business:* to elect an Auditor for the forthcoming audit, *vice* Mr. F. H. Rayment, F.C.P.A., who is eligible for re-election; and who is recommended, by the Council, for election (in accordance with the provisions of Rule xvi.).

No other nominations having been received, the President declared Mr. F. H. Rayment duly elected.

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*(From the respective Societies, etc., unless otherwise mentioned.)*

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The following notice was inadvertently omitted from p. 434 :—

Mr. Henry Deane delivered an address on the physiography and botany, with a résumé of the reports of Mr. H. Y. L. Brown, Government Geologist of South Australia, and Mr. C. G. Gibson of the Geological Survey of West Australia, upon the geology, of the country along the route of the proposed Transcontinental Railway Line, between Port Augusta, S.A., and Kalgoorlie, W.A. By the aid of a large map, and a series of most informing lantern-slides, for the most part from photographs taken by himself, Mr. Deane succeeded in arousing and holding the attention of his audience, as well as in whetting a desire to learn more of a region which offers so many scientific problems for investigation, and is so little known to naturalists.

The President, on behalf of the Meeting, tendered to Mr. Deane very cordial thanks for his most interesting and enlightening contribution to the business of the evening.

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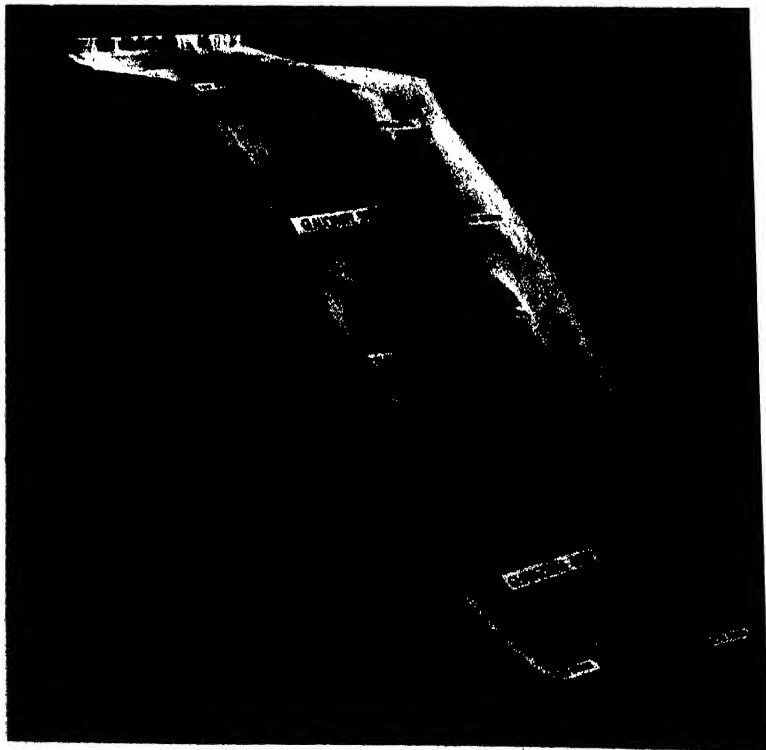


Full-face View of Metal of the Apparatus

to the Machine



PLS NEW 1910



View of the Model of the Submarine Slope off Sydney foreshortened and seen from a lower Plane than in Pl. I.



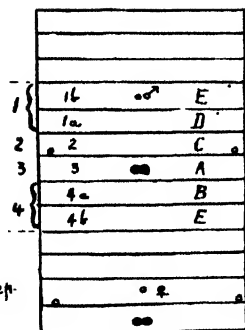


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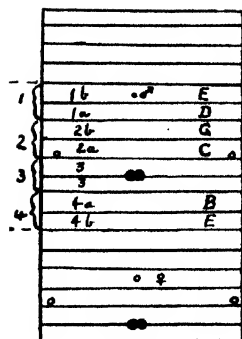
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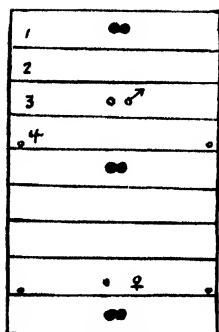
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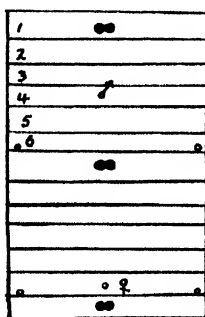
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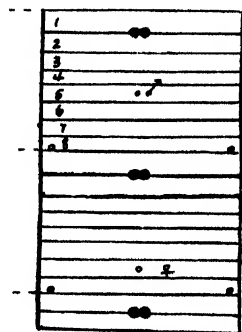
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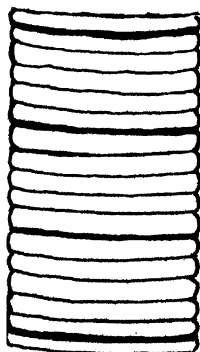
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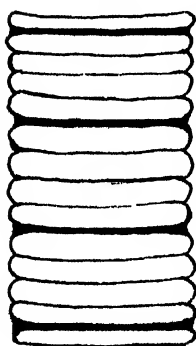
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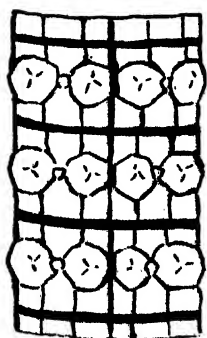
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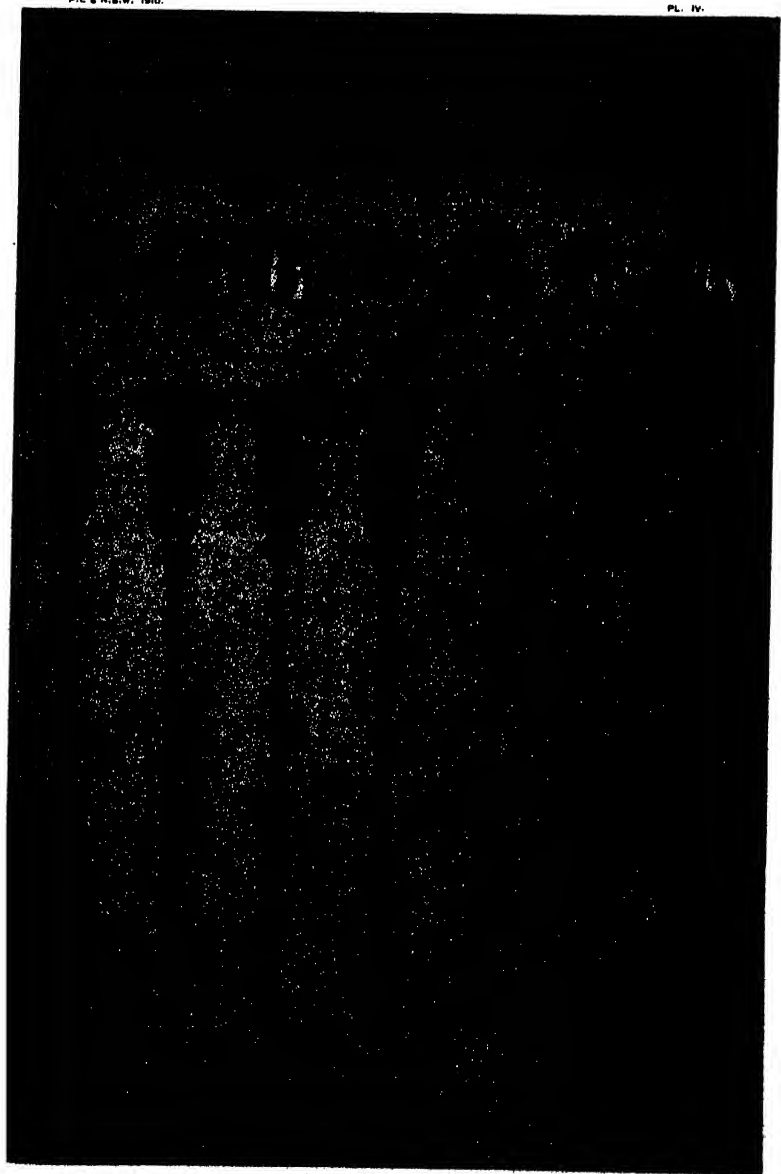
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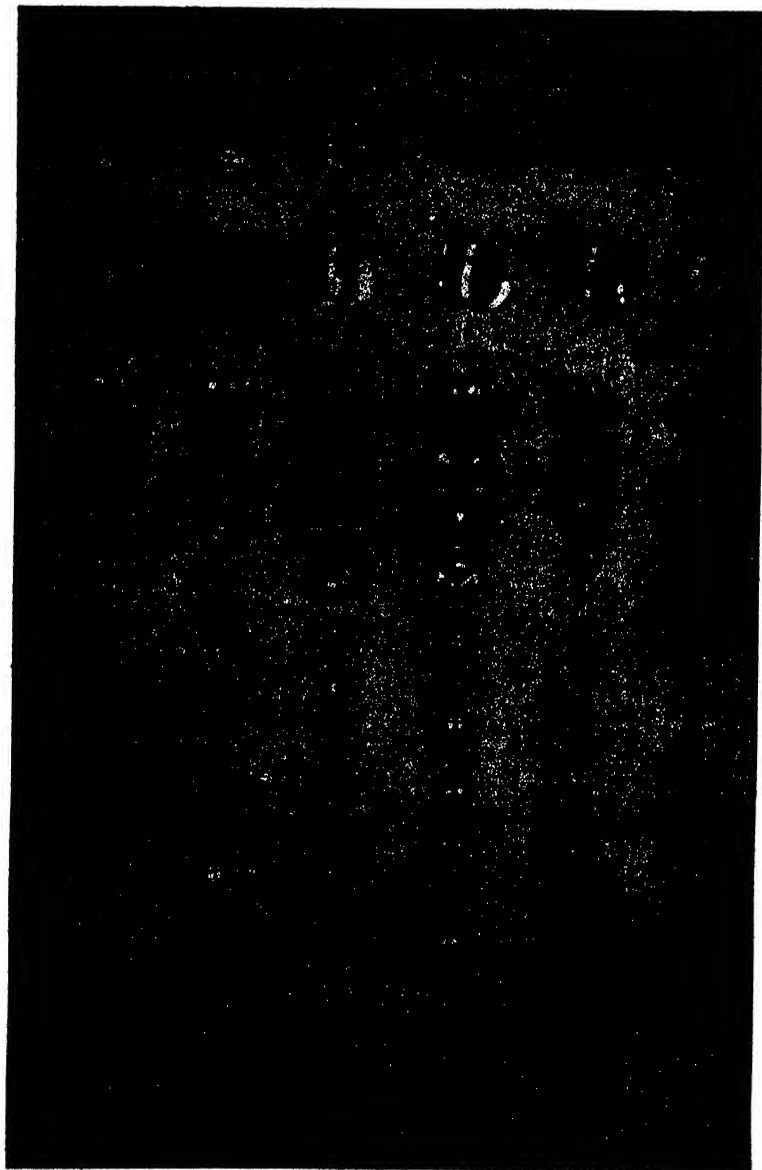
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Diagrams showing the arrangement of the Annuli in the Genital Somite of Hirudines.

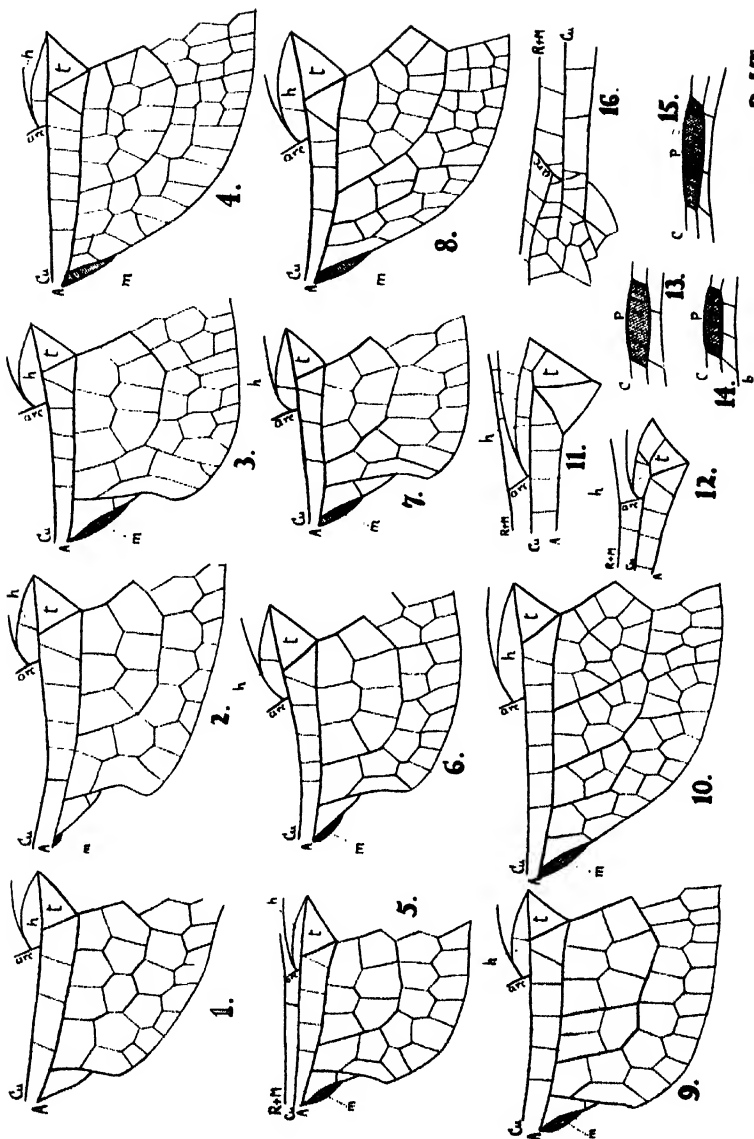








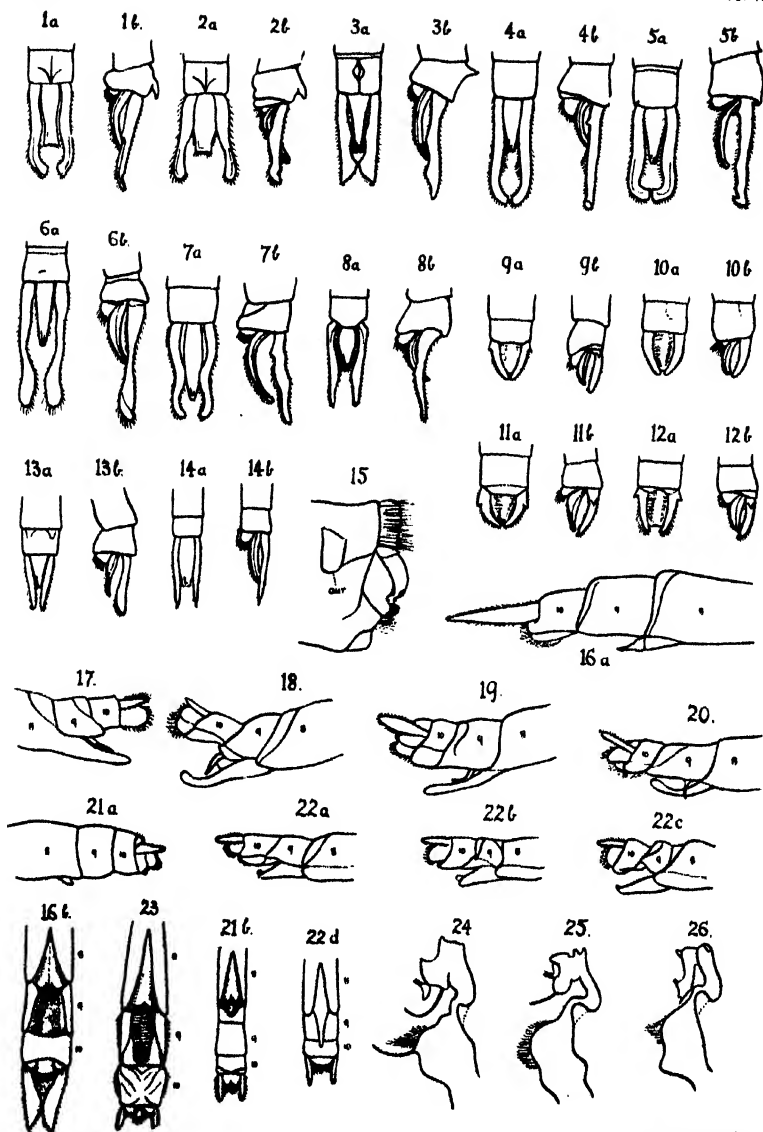




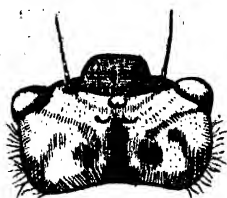
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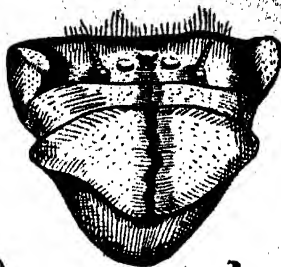


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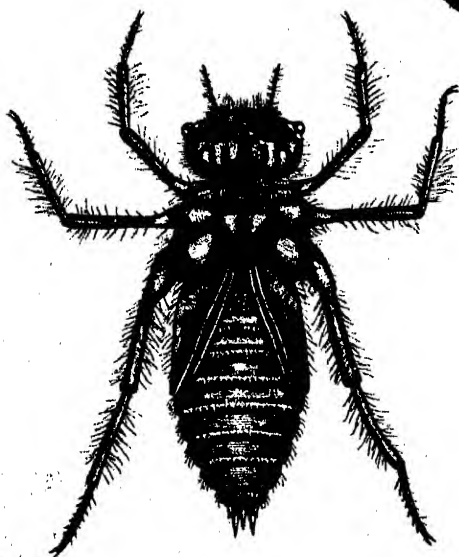




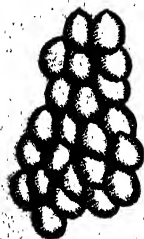
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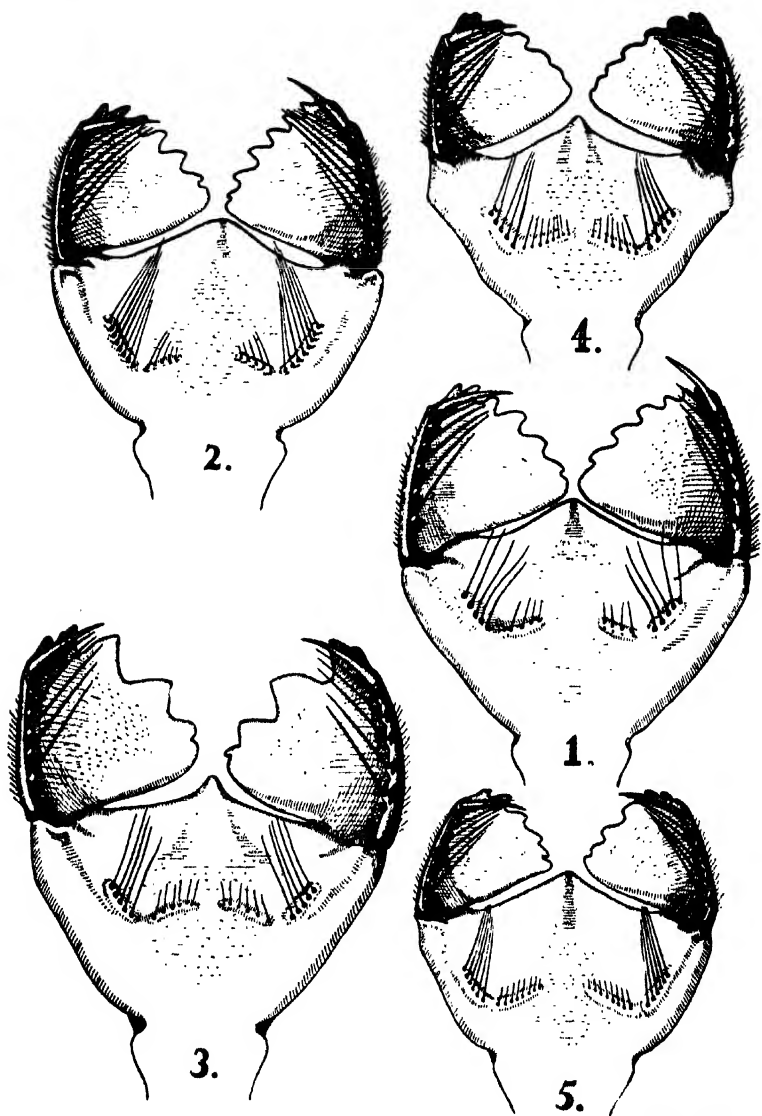
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4.

Figs. 1-4, *Synthemis eustolacta*. Fig. 5, *Metathemis guttata*.





*R.J.T. del.*

Labia of Nymphs in *Synthemis* (Figs. 1-3), *Metathemis* (Fig. 4), and *Choristhemis* (Fig. 5).



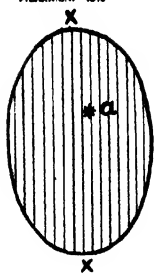


FIG. 1.

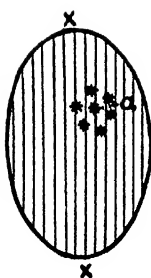


FIG. 2.

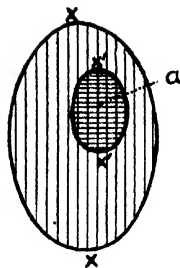


FIG. 3.

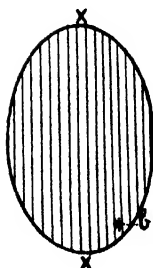


FIG. 4.

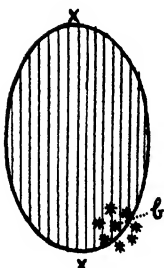


FIG. 5.

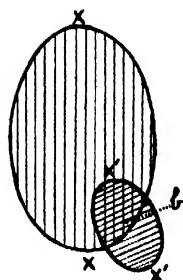


FIG. 6.

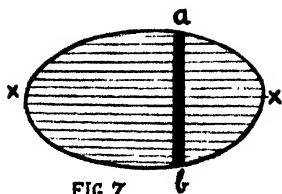


FIG. 7.

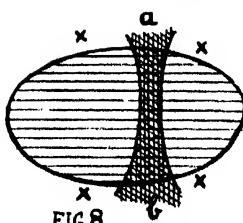


FIG. 8.

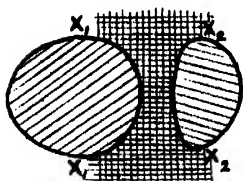


FIG. 9

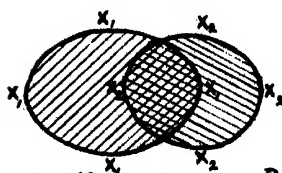


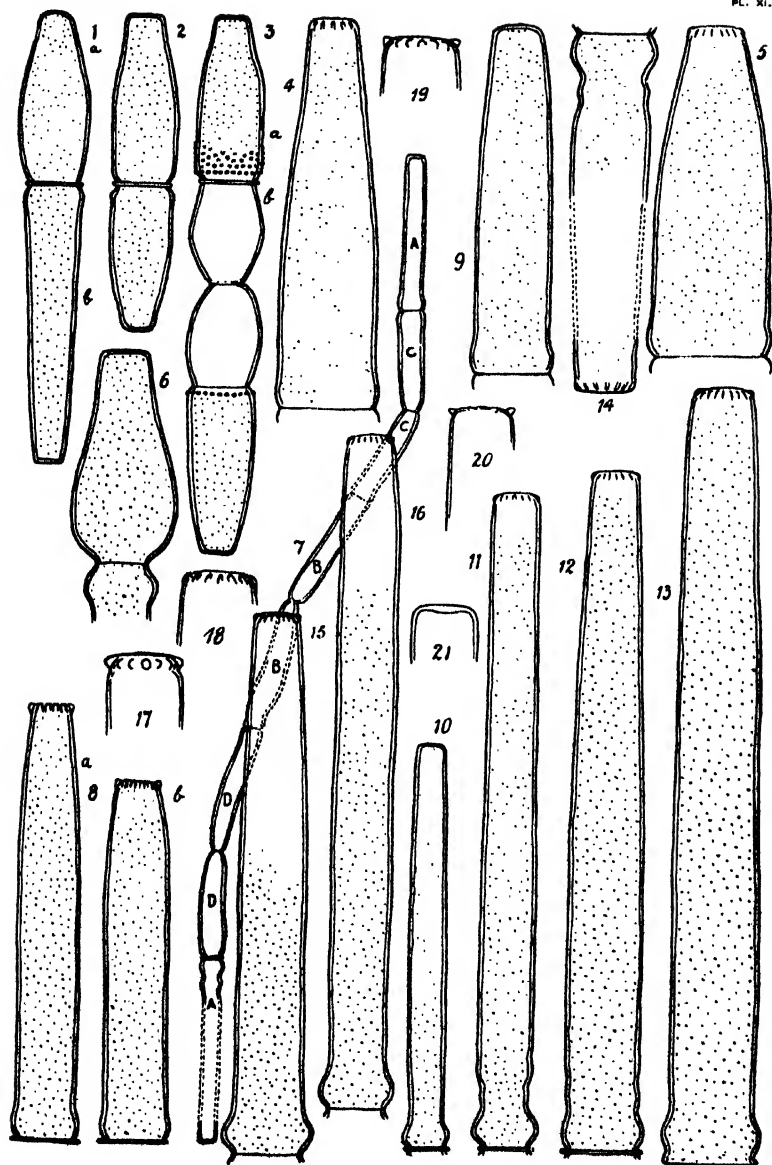
FIG. 10.

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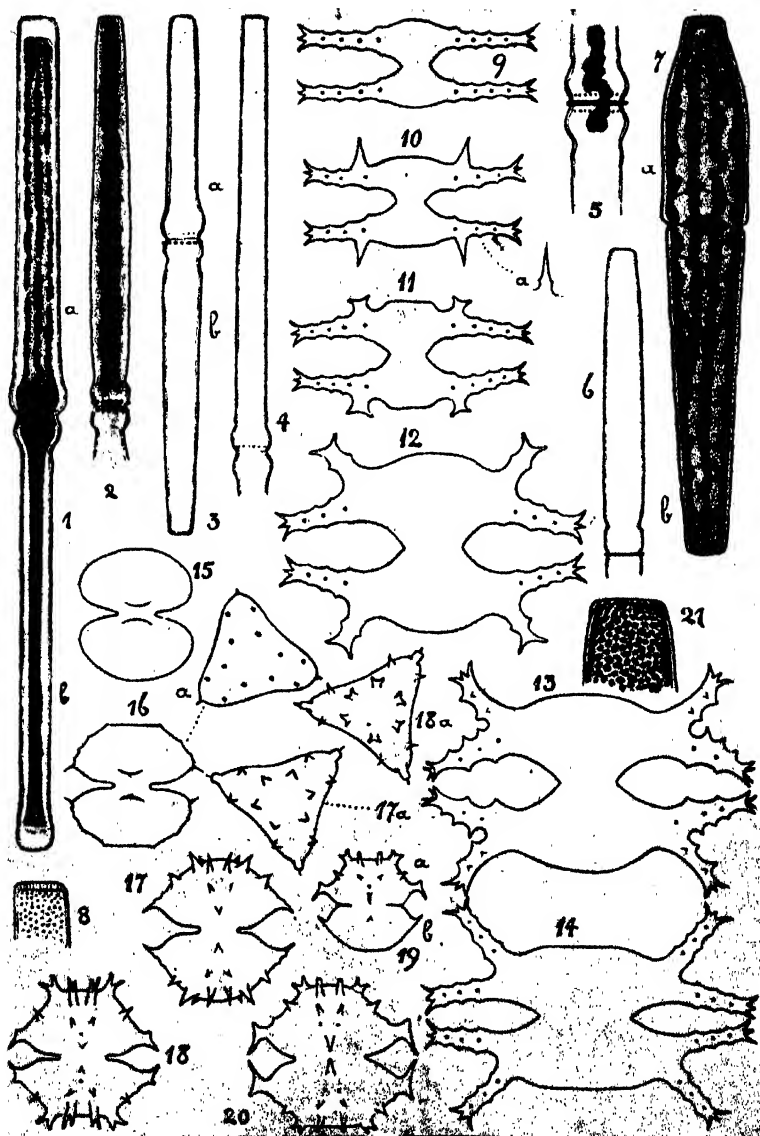
Development of Inlying (1-3), Overlapping (4-6, and 10), and Isolated (7-8) Pairs of Species.





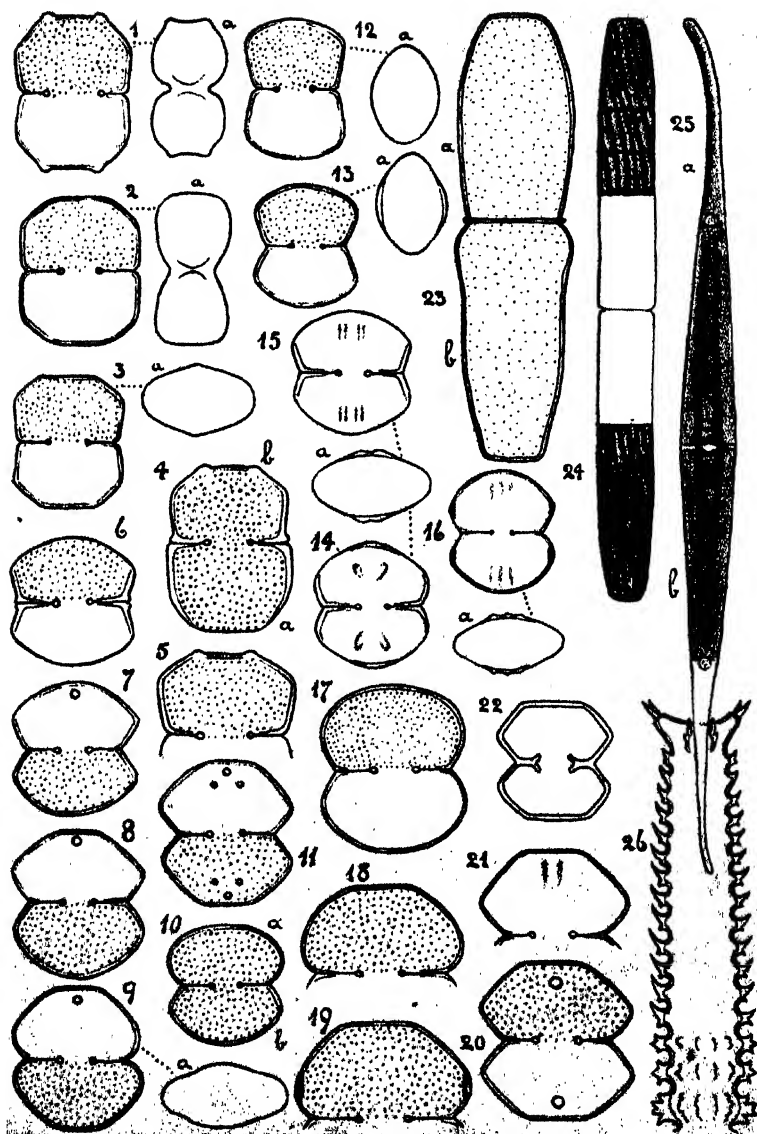
*Decidium trabecula* (Ehr.): forma.





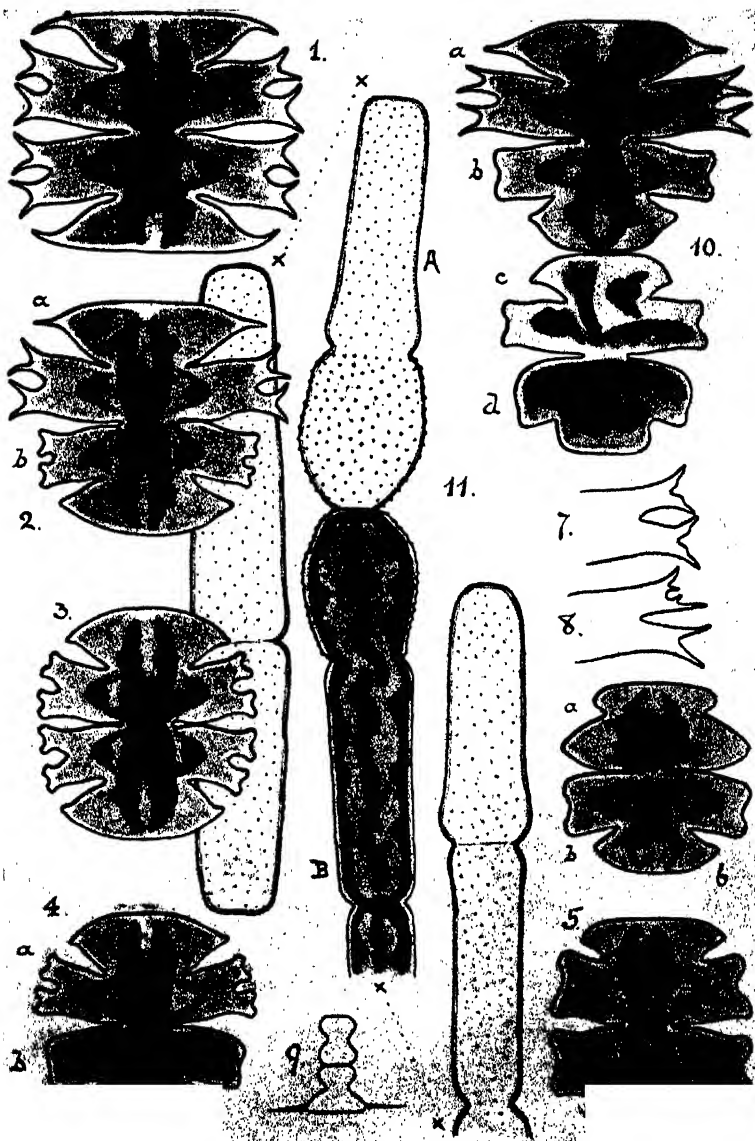
Growth of spines and processes in *Dapidium* and *Staurastrum*.





*Cosmarium rectangulare* Grun.: forms.





Illustrations of the Results of continued Cell-division.





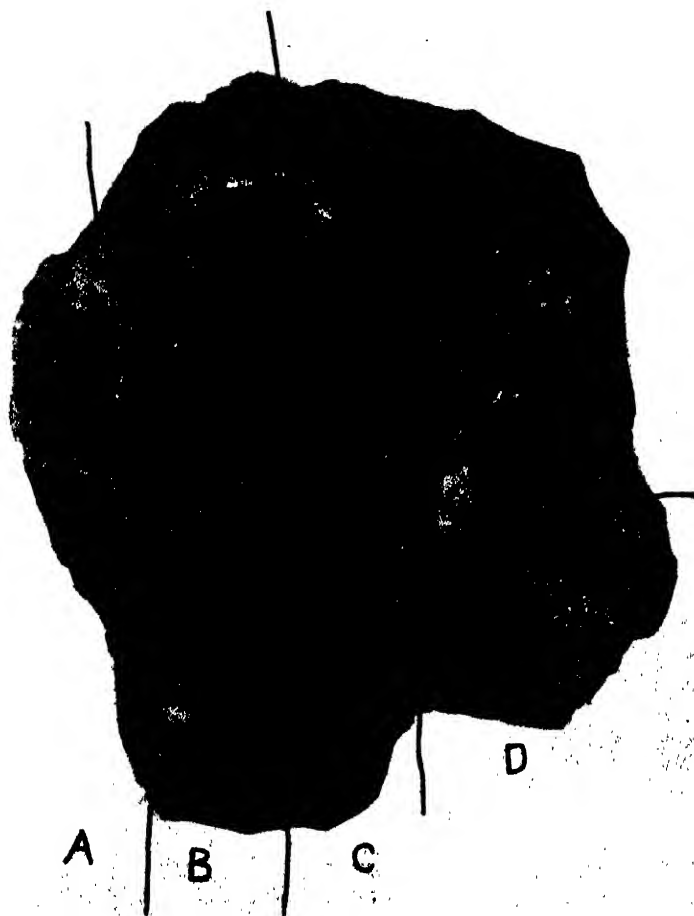


Fig. 1. Borah Creek, showing how the line of lode corresponds with the Creek, and the effect of faults.



Fig. 2. Specimens illustrating the metasomatic replacement of quartz by sphalerite.





Portion of Conrad Lode, illustrating banding.





Fig. 1.

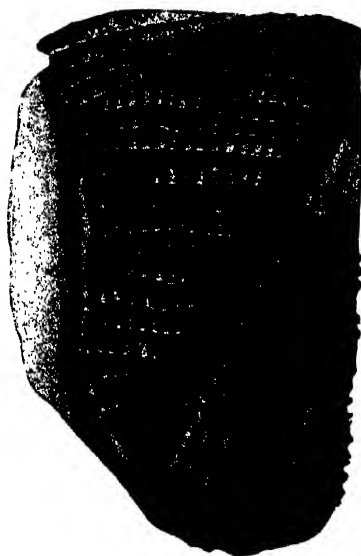


Fig. 2.

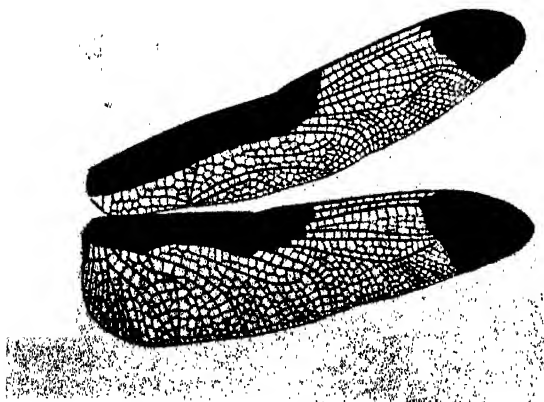


Fig. 3.

Fig. 1—One-half valve of *Loricis duniana*, n.sp.

Fig. 2—One-half valve of *L. solvor* Reeve

Fig. 3—Wings of *Camacinta Othello* (female) Tillyard.

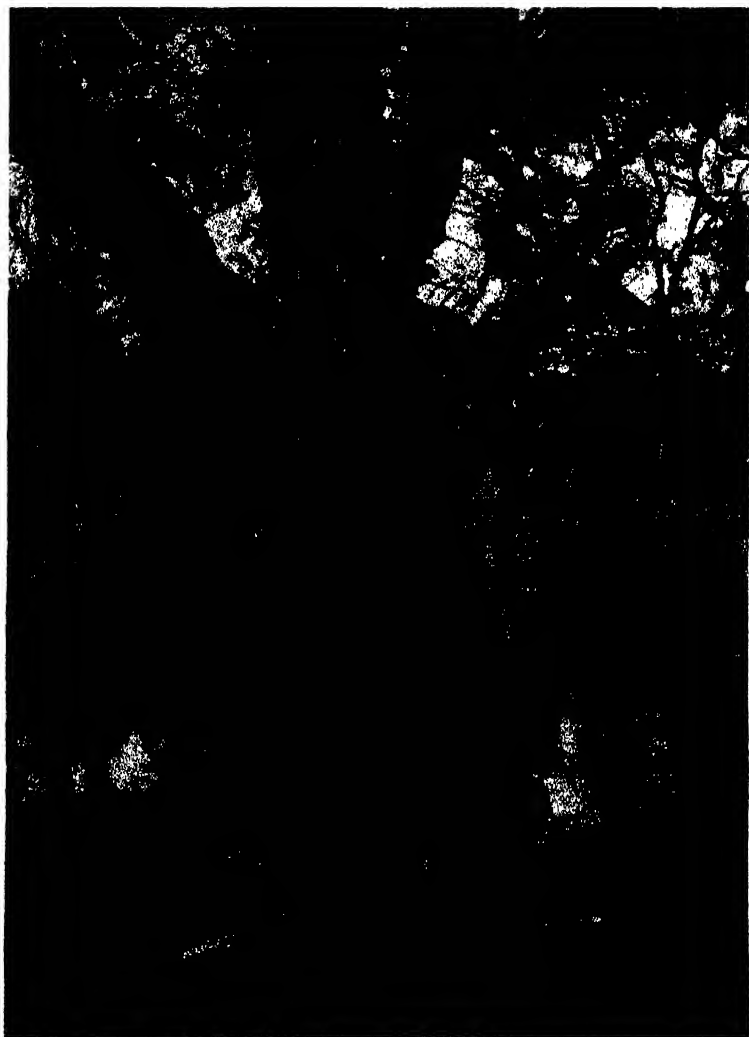




Adventitious Roots of *Melaleuca linariifolia* Sm.

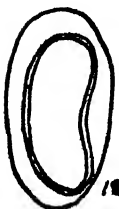






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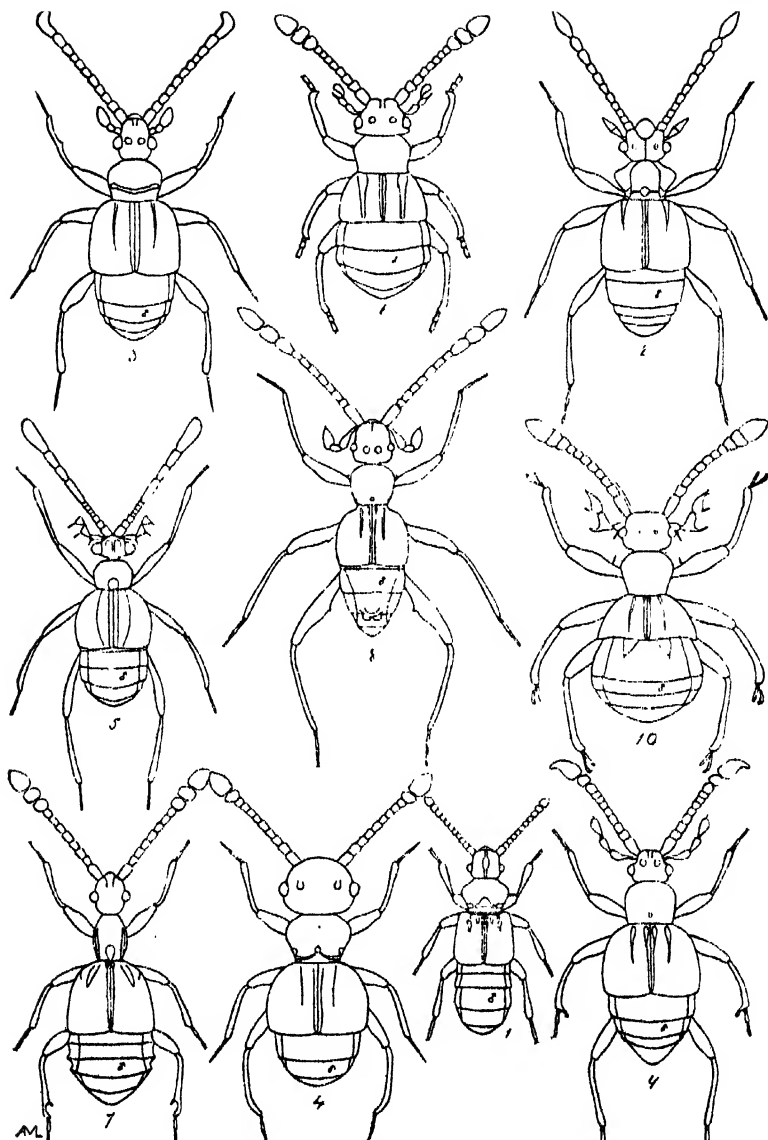
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*Australian and Tasmanian Psaltripidae.*

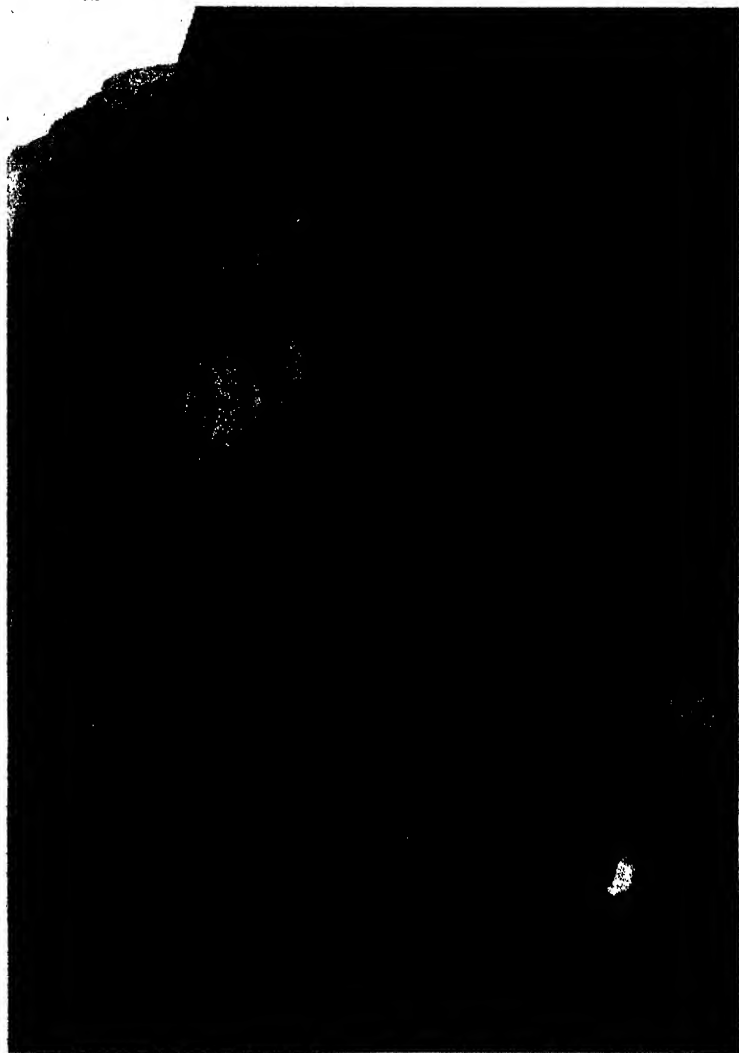




Mounts Gower and Lidgebird, Lord Howe Island.

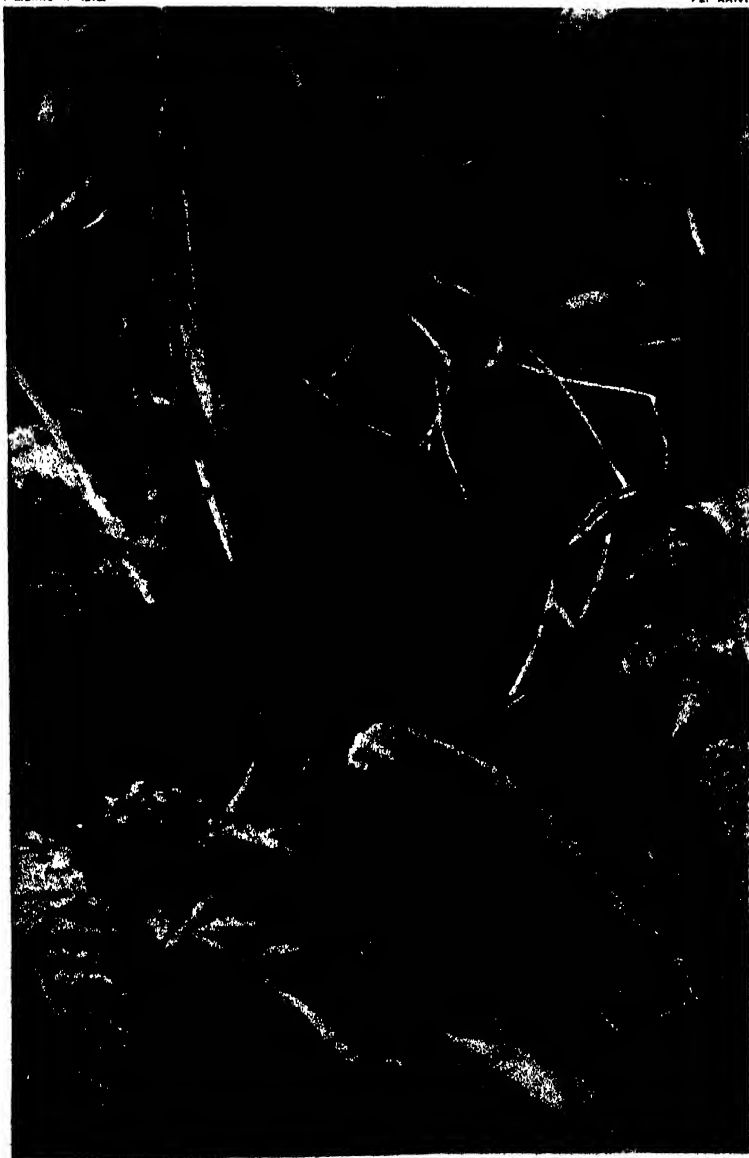






The Lower Road, Mount Gower: a breeding-place of *Oestrelata*.





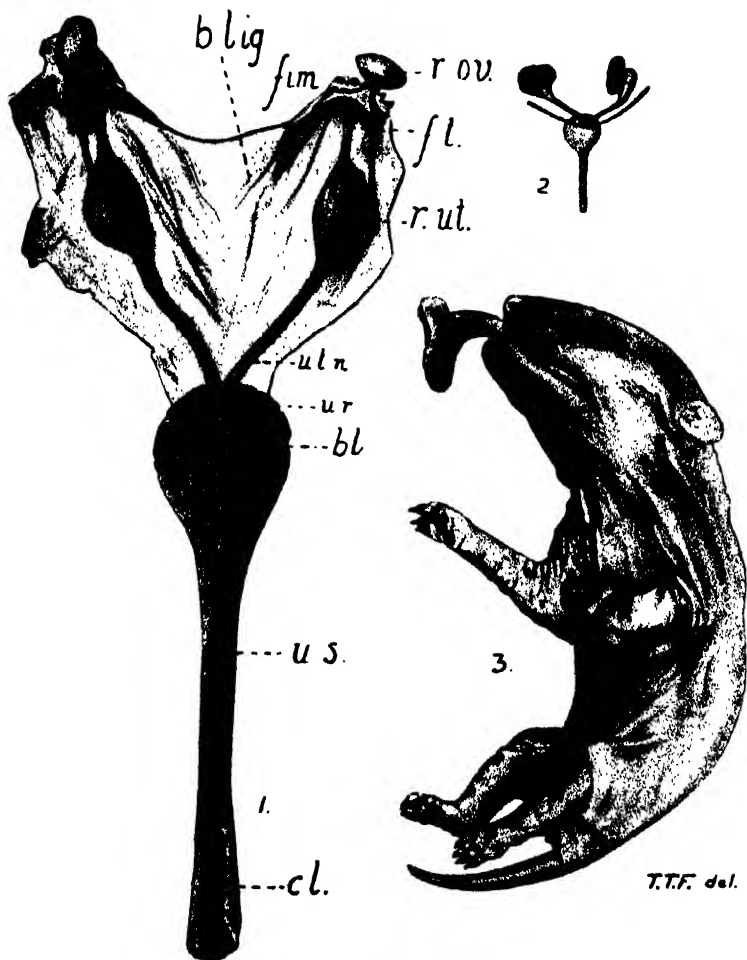
*Oestrelata montana* ; adult at entrance of burrow.





*Oestrata montana* : nestling placed above entrance of burrow.





T.T.F. del.

*Sarcophilus satanicus.*





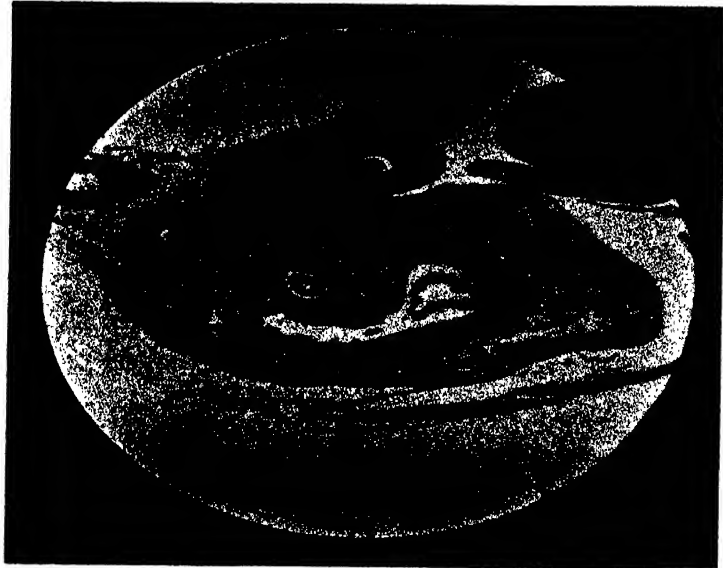


Fig. 4. *Sarcophyllus satanicus* (see p. 578.)



Fig. 5. *Sarcophyllus satanicus* (see p. 578.)





Fig. 6. *Sarcophilus satanicus* (see p. 877).



Fig. 7. *Sarcophilus entanicus* (see p. 877).





Fig. 8. *Sarcophilus satanicus* (see p. 882).



Fig. 9. *Sarcophilus satanicus* (see p. 882).





Fig. 10. *Sarcophilus satanicus* (see p. 883).





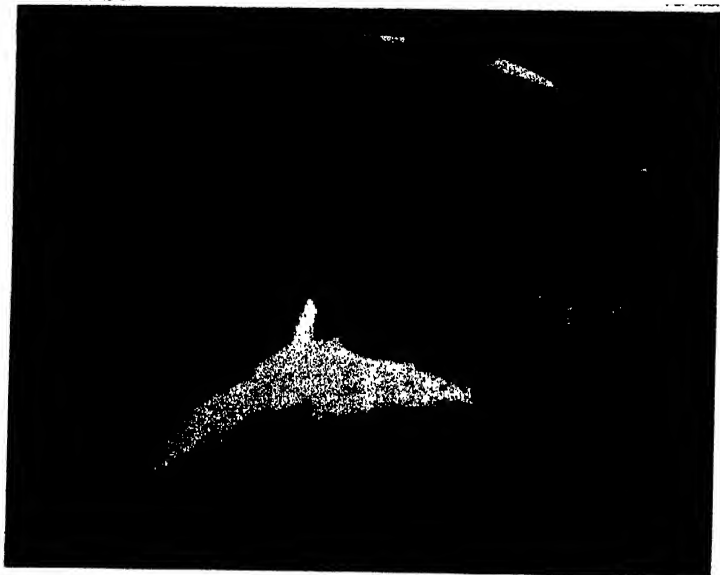


Fig. 11. *Sarcophilus satanicus* (see page 884).

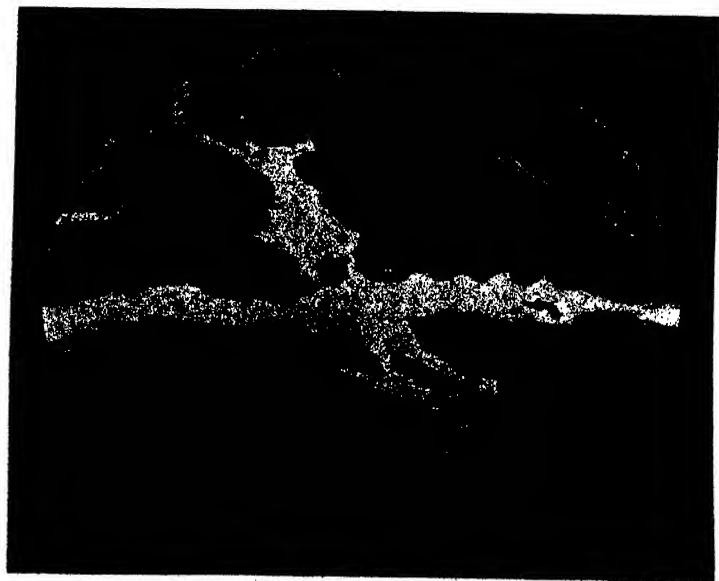


Fig. 12. *Sarcophilus satanicus* (see p. 884).



